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JOURNAL
of
FARM ECONOMICS

Annual Meeting, State College, Pennsylvania, August 23-25, 1954

UNIVERSITY OF MICHIGAN

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Price: $5 per year, this issue $1.25

Entered as second class matter at the post office at Menasha, Wis. Acceptance for mailing at a special rate of postage provided for in the Act of February 28, 1925, paragraph 4, section 412, P. L. & R., authorized November 27, 1931. Printed in U.S.A.

THE JOURNAL OF FARM ECONOMICS is published five times a year during February, May, August, November and December by The American Farm Economic Association. Yearly subscription $5. Published at Menasha, Wisconsin.

JOURNAL
OF
FARM ECONOMICS

Volume XXXVI AUGUST, 1954 Number 3

THE POLITICAL STRATEGY OF AGRICULTURE*

ERNEST A. ENGELBERT
University of California at Los Angeles

THE political environment in which agriculture operates is rapidly changing to the disadvantage of the voice and position of agriculture in national policy. The political shifts which are taking place have significant implications for agriculture's future political strategy. To maintain political influence proportionate to their importance in the national economy, farmers will have to reshape their political outlook. It is the objective of this article (1) to briefly note some of the concepts which currently govern agriculture's political operations, (2) to set forth a few political conditions which should guide agriculture's future actions, and (3) to indicate changes that should take place in agriculture's strategy relative to political parties and pressure groups.

Agriculture has Distinctive Political Operations

No group in American politics has operated under such distinctive political concepts and arrangements as farmers. Ever since the mid-nineteenth century agriculture has been treated as a somewhat separate political problem. Until recently at least the prevailing outlook has been that the economic and social problems of agriculture were so different from other segments of the national economy that they could not be dealt within the same context with other national issues. Separate consideration also appeared warranted because agriculture was looked upon as both the basic and crucial industry in the nation's growth and prosperity. Whatever other reasons could be cited, this view led farm leaders to try to deal with the economic problems of agriculture insofar as possible outside of the general political process.

Closely associated with the concept that agricultural problems deserved

* Portions of this paper were presented to the National Work Conference on Public Policy sponsored by the Farm Foundation at Green Lake, Wisconsin, September 1953.

special political treatment was the belief that the ideals and virtues found in agrarian life were best for American democracy. Farmers have looked upon the political institutions of urban communities with suspicion and distrust and have generally attempted to insulate agriculture from what were regarded as the corrupting influences of business, labor, and city politics. Consequently agricultural policies have been weighted with a strong carry-over of nineteenth century concepts and traditions which built political barriers between farmers and other groups in American society who interpreted political and economic progress in terms of technology and urbanization.

The point of view that agriculture's problems should be dealt with separately, both on an economic and a political basis, has led to the development of an unusual set of political arrangements for agriculture. Most striking has been agriculture's efforts to operate on a non-partisan basis. Farmers and agricultural leaders have gone on the premise that there was a non-partisan approach to farm problems and that intense involvement in the political process was some thing to be avoided.[1] Partly as a result of the bitter lessons which were learned from their ventures into direct political action during the great period of agricultural discontent following the Civil War, farmers have felt that during periods of relative prosperity such as preceded World War I they did not have to alienate either major party by formulating unacceptable farm programs. Similarly, they reasoned that during periods of agricultural depression such as took place during the 1920's and 1930's programs could be more effectively formulated through the administration in power on a bi-partisan basis rather than through the party in power on a partisan basis.[2] The non-partisan approach has not only dominated both party and group strategy but has influenced the way rank and file farmers have participated in their local political organizations.

Another distinct feature of agriculture's political operations has been the way it has relied upon legislative bodies to protect its political fortunes. Inasmuch as legislative districts have been so distributed as to give rural people state legislative and congressional representation far out of proportion to their numbers, the farmers' alliance with the legislative body

[1] For a short statement which reflects a typical farmer's attitude toward the political process see Martin A. Lauterbach, "Keep Partisan Politics Out," *Farm Policy Forum*, May 1950, pp. 31-32. For two longer studies which depict how agricultural groups have tried to skirt clear of involvement in party politics see Charles M. Hardin, *The Politics of Agriculture, Soil Conservation and the Struggle for Power in Rural America* (Glencoe, Ill., The Free Press, 1952), and Grant McConnell, *The Decline of Agrarian Democracy* (Berkeley, University of California Press, 1953). For the best over-all historical account of the growth of farm movements in the midwest the reader is referred to Theodore Saloutos and John D. Hicks, *Agricultural Discontent in the Middle West, 1900-1939* (Madison, University of Wisconsin Press, 1951).

[2] Saloutos and Hicks, *op. cit.*, Chaps. XIII-XVIII.

is natural. Particularly at the national level, farmers have assiduously groomed agricultural spokesmen in Congress and have encouraged the existence of a Congressional farm bloc.[3] Congress in turn has continued to exercise considerable leadership in the formulation of agricultural policy despite the rapid growth in influence and power of the President and agricultural agencies.[4]

The agricultural political environment has likewise been unique because of the unusual relationships that have been worked out between governmental agencies and farm groups. Indeed, no other political group has developed such a close liaison with public officials through the land grant colleges, the Extension Service, the experiment stations, PMA, SCS, and other programs or participated to such an extent in administrative decisions and the operation of programs. These ties have enabled farmers to partially circumvent established political channels in acquiring assistance and aids.

While these and other distinctive conditions of the political environment have undeniably been a source of strength to agriculture in the past, they will need to be modified if agriculture is to remain politically successful in the future. Agriculture has been steadily declining both in relative industrial importance and in terms of the number of people directly engaged in its activities. The nation is moving farther and farther away from the rural dominated society of the nineteenth century. These changes have significant implications for the way in which agriculture should operate politically.

Moreover, the formulation of agricultural policy is increasingly involving issues that cut clear across our national political and economic fabric. The extent to which other groups are becoming directly concerned about agricultural policy is reflected by the volume of mail that the Secretary of Agriculture is receiving from urban constituents.[5] In the interdependent economy in which we live, it is dangerous for agriculturalists to assume that their political diagnosis of the agricultural situation is most valid for national policy or that policies should be made by farmers for farmers.

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[3] Charles M. Hardin, "Farm Politics and the Separation of Powers," a paper presented to the National Work Conference on Public Policy, *op. cit.*, (mimeo.) pp. 3-5.

[4] Some indication of the importance of Congress in agricultural legislation is to be found in Lawrence Henry Chamberlain, *The President, Congress, and Legislation* (New York, Columbia University Press, 1946).

[5] *The New York Times* of January 3, 1953 reported that ninety percent of Secretary Benson's mail was running in his favor and that the general theme sounded "like an urban consumers' revolt against farm subsidies." Other newspaper stories in recent months have commented upon the rising number of editorials which have attacked the farm bloc for trying to develop farm programs which were regarded as not in keeping with the national welfare.

Already there are signs that the political strategy which farmers have used in the past is beginning to boomerang. The non-partisan approach began to crack seriously at the seams when the debate on the Brannan plan first took place.[6] The first year of the Eisenhower administration finds the farm pressure groups having a much more difficult time keeping the executive branch in harmony with the leadership formerly exercised by Congress. The methods used by the farm-rural bloc in various states to restrict the growth and political readjustments of urban areas is resulting in growing disaffection by the urbanite for farm groups and their problems.[7]

No group such as agriculture which is in the political minority in a democracy can afford to use outmoded political, legislative or governmental organization to perpetuate itself in political power. If the cleavage between farm groups and non-farm groups continues to grow in a society which is becoming proportionately less agricultural, the farmers will inevitably suffer dire political consequences. Agriculture needs to take a long range view of its political future. It is in no position to run the risk of winning temporary but dubious political victories at the expense of losing long time gains of a more enlightened political campaign.

Political Conditions Guiding Agriculture's Action

Any analysis of how agriculture should operate politically is not without Machiavellian implications. Nevertheless agriculture needs to realistically and continually weigh its status of political influence and power vis-a-vis that of other political organizations and pressure groups. The following paragraphs set forth some general conditions which should guide agricultural political actions in the future. These criteria, however, should not be regarded as providing acceptable substitutes for well-formulated agricultural policies.

Perhaps the first political condition for agriculture to observe is that as a political minority it needs to be proportionately more watchful of its political strategy and power base than if it were a majority group. Although minority groups do not necessarily suffer disproportionate loss of political power as they grow smaller, nevertheless, unlike majority groups, they are not able to dominate the situation by sheer numbers alone. This means that minority groups have to follow more closely the impact of

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[6] Theodore W. Schultz, "The Turbulent Brannan Plan," *Farm Policy Forum*, February 1950, p. 5. The Farm Bureau openly denounced the Brannan plan as a threat to the bi-partisan farm policy—*The Nation's Agriculture*, Vol. 24, March 1949, p. 7 (cited in Grant McConnell, *op. cit.*, p. 141).

[7] Numerous illustrations of the growing resentment of urban dwellers to the enactments imposed by farmer-dominated legislatures are found in Robert Bendiner, "How the Farmer Rules Your City," *Colliers*, November 7, 1953. This article was reprinted and distributed widely by the National Municipal League.

their policies and tactics upon other segments of the political environment and to carry on corollary programs of education and influence. That agriculture has much to learn on this score is reflected by the political walls it has tried to build around its activities. Farmers will have to recognize that they must proliferate their points of contact with the public in numerous ways and that to do so calls for better understanding of the political outlook and methods of non-farm people and organizations.

Another political fact of life of which agriculture should be cognizant is that a minority group must either exhibit great internal solidarity and cohesiveness or form alliances with other pressure groups if it wishes to exercise maximum influence on public policy.[8] Greater unity in the farm movement depends upon amalgamation of viewpoints and interests to the point where one farm organization could speak as the representative voice of agriculture. Although the Farm Bureau Federation in particular has not infrequently tried to appear as the sole spokesman for farmers, big economic, regional, and commodity group cleavages make a united front very difficult to attain, except occasionally upon some single issue. It appears more likely instead that in the future various farm organizations will try increasingly to work out alliances with other groups to give them more bargaining power. The trend toward inter-group cooperation will, of course, inevitably push farmers farther out into the sea of partisan politics.

Closely associated with group strength is the need for farmers to take advantage of the regional characteristics of agriculture to promote regional alliances which will foster the interests of the regional economy including the interests of agriculture. Whereas agriculture may not be able to work out political cooperation with another pressure group on a national basis it may be able quite easily to arrange regional ententes.[9] To be sure, the aims and programs of regional blocs may be quite selfish and provincial and not in accord with the national interest, but nevertheless it is a political fact that strong regional political groupings usually acquire political power at the national level far beyond their size. The farm group which develops an organizational structure which can sit astride regional blocs will have gone a long way toward building a political power base that will not easily be challenged by a majority group no matter how strong.

There is also reason to believe that farmers as a significant political minority group should increasingly operate on the basis of acquiring and maintaining the balance of political power. For example, there is evidence

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[8] The importance of group cohesion for policy-making is well treated in David B. Truman's *The Governmental Process* (New York, Alfred A. Knopf, 1951), Chapter 6.

[9] Some of the difficulties of keeping a national organization with great regional cleavages intact are reflected in Orville M. Kile, *The Farm Bureau Movement through Three Decades* (Baltimore, The Waverly Press, 1948).

that agriculture is currently in a position to tip the scales between industry and labor or to decisively shift the relative strength of the two major political parties. Maintaining the balance of power, however, calls for a different kind of political strategy from the tactics that might be employed if the main objective was to seek dominance or to gain recognition as a strident and vociferous minority. A minority group which hopes to gain a pivotal political position needs to win political respect from other groups and to appear as a compromising agent between more divergent forces. This calls for tolerant outlooks, artful negotiations and accommodating actions. It must be admitted that to play this role agriculture will have to undergo nothing short of a metamorphosis of its own political values and habits.

The nature of agriculture's political action at any particular time needs also to be conditioned by the relative strength of the two major political parties in their relation to other groups as well as to the administration in power. Agriculture should not try to use one party solely as its vehicle. Agriculture embraces far too many varying issues, regions and political viewpoints for it to make best progress in one political party. Moreover, the major political parties, as past American experience has shown, have frequently shifted roles, so agricultural interests may be best served by likewise shifting political ground with the parties. It will probably always be more advantageous for agriculture to exert its greater influence upon which ever party is in power, particularly because of the strong working relationships that farm groups have with administrative agencies at the national level. However, agriculture needs to be careful that it does not press its political-administrative advantages to the point where it falls out of favor with the political groups that will constitute the controlling forces of power when a party change takes place. A minority political group which wishes to hold the balance of power cannot afford to act as a major group which hopes to dominate the political party.

Changes that may occur in the distribution of power and functions among the federal, state and local levels of government will affect the future course of agricultural political action.[10] If more agricultural activities gravitate to the national level farmers will probably find it to their advantage to strengthen the activities of the national farm organizations as well as their base in the political parties to provide a countervailing balance of power. Contrariwise, the political organization of farmers can probably be somewhat looser and dispersed if certain functions and responsibilities are returned to the states. In any case agriculture should use

[10] W. Robert Parks, "Federal-State Relationships in Agriculture," a paper presented to the National Work Conference on Public Policy, *op. cit.* (mimeo), 13 pp. See also John D. Black, *Federal-State-Local Relations in Agriculture,* Planning Pamphlet No. 70, National Planning Association, 1950.

its political forces to see that no level of government acquires responsibilities for which the decision-making process cannot be kept visible and effectively controlled.

The types of political action which farmers should take also vary with the degree of economic prosperity which exists and the relative economic status of farmers in comparison with other groups. Unfortunately, farmers have suffered so many years of below parity standards during the last three-quarters of a century that they have been unconsciously employing the same political tactics during good as well as bad years. They have not recognized that it is more difficult politically to demand the same types of economic assistance in times of prosperity as in times of depression. Farmers also need to remember that group tensions may be sharper during periods of economic dislocation and that the best time to work out major policy changes is when there is enough play in the economic system to permit easy compromises with other groups. This suggests that as a minority political group it may be increasingly advisable for farmers to rely more upon forward planning. In other words, periods of political good will should be used advantageously to formulate policies and legislation to cover future contingencies.

Finally, political action by farm groups should be determined by the nature of the ties that have been developed between various segments of agriculture and administrative agencies. Given the condition of declining political power for agriculture, farmers will increasingly need to turn to administrative agencies for assistance and protection in the political environment. Administrative agencies are expected to be the spokesmen not for specific political forces but for the problems involving the public interest which these forces present. Administrative agencies therefore acquire a certain measure of political power by virtue of being part of a government responsible to the total public which specific interests such as agriculture cannot attain. Indeed, insofar as agriculture remains important to the national welfare it may be expected that the political influence of administrative agencies will increase in much the same proportion as the political influence of the farm population declines. How farmers can get the maximum political support of administrative agencies without sacrificing an undue amount of political freedom is, of course, a difficult question. Needless to say the more complicated private-governmental-agricultural relations become, the more discerning agricultural people will have to be concerning administrative agency-private group relationships.

Indicated Changes in Agricultural Strategy

While there are many ways whereby farmers can become politically more effective, agriculture in particular needs to reshape its strategy with

respect to political parties and pressure groups. Parties and pressure groups have not been used effectively to maximize agricultural political influence because farmers have tried to insulate agriculture from the general political process. These political instruments have been viewed primarily as intra-organizational devices to achieve agricultural unity. Hence they have not been adequately employed in inter-organizational activities with non-farm political forces and groups.

In general agriculture's over-all political strategy should be to pursue tactics that will offset the loss of power at the voting booth. To accomplish this objective calls for a reorientation of agriculture's relationships to other economic interests and segments of our society. Farmers need to foster programs designed to interpret the problems and goals of agriculture to labor, industry, and urban groups. In turn, farmers should be more sympathetic to the aspirations of non-agricultural peoples. Political parties and pressure groups are the best vehicles for accomplishing this reorientation because of the access which they afford to the over-all political and social environment.

The Political Party. With respect to agricultural tactics within political parties, it should be noted that agriculture's influence in the political party has dropped as the strength of other groups has risen. Farmer impact upon party policies and farmer access to party organization in recent years has been maintained largely through the influence of agriculture spokesmen in legislative bodies and not as a result of farm influence in the hierarchical levels of party organization. The rank and file farmer does not take party organization seriously, nor has he wanted farm leaders to become so beholden to party policies that they could not speak uncompromisingly on behalf of the farmer.

On the whole agriculture has not perceived that the best protection farmers have against the new types of power relationships and economic involvements that are generated by our interdependent society is the political party. No other human institution approaches the party in its effectiveness to oversee and guide the total political process. The party is not only the best instrument yet devised to equate competing values in our political system but it is likewise the best organ to assure that the rationalization of values is done democratically. Insofar as farmers withdraw from party participation they are bound to find themselves in the uncomfortable position of having more and more decisions affecting the welfare of agriculture made in areas of the political arena over which they have no control.

The role which agriculture should play in party activity depends to some extent upon how the major parties evolve. If we maintain a party system in the United States in which the two major parties try to maintain the balance of power by working out compromises between divergent

groups and regions, then farmers can probably use pressure group organization and tactics more effectively in the party-policy-making process.[11] But if we move toward a more disciplined form of party organization in which the two major parties endeavor to centralize more responsibility for political decisions within the party organization, then farmers will be forced to work more through all levels of party organization to attain their objectives.[12]

But irrespective of how parties evolve, farmers need to play a bigger part in party activity to offset agricultures declining political influence. Specifically what should be agriculture's program in connection with political party organization? Though a detailed program is not easily spelled out the following trends should be fostered.

Agriculture should frankly recognize the dangers of becoming a politically isolated and narrow-minded interest group. The party should be viewed as a medium of keeping contact with the over-all political environment and the social values of the non-agricultural society. Agricultural leaders and agencies who are in a commanding position to influence farm opinion should take the lead in changing the attitudes of farmers to political parties. Farm groups should encourage their membership to freely participate in party organizational activities.

The party should be used as a means of acquiring access to and influencing other groups. This needs to be done at all echelons of the party organization and not, as in the past, simply at the top. A concerted program of interpreting farm problems and selling farm policies to the rest of the party membership can be profitably carried on by both individual farmers and farm groups. Farmers should not try to pin the party down on a host of specific issues or get it to spell out a detailed farm program in its platform. Instead farmers should focus upon a minimum number of basic policies and on these push for firm party commitments and support.

Finally, farmers should look upon the parties as instruments for policing the actions of other political organizations. Party surveillance of other groups also applies to administrative agencies. Farmers can protect their own welfare by seeing to it that the parties are always strong enough to offset the threat of being dominated by a specific interest group. Farmers

[11] Books which support the theory that parties should function as agents of compromise include: Pendleton Herring, *The Politics of Democracy* (New York, W. W. Norton & Co., 1940); William Hesseltine, *The Rise and Fall of Third Parties from Anti-Masonry to Wallace* (Washington, D.C. Public Affairs Press, 1948); and Arthur H. Holcombe, *The Political Parties of Today* (New York, Harper and Bros., 1924).

[12] Perhaps the most effective presentation of the theory that parties should function as disciplined organizations is to be found in E. E. Schattschneider's *Party Government* (New York, Rinehart & Co., 1942). A recent report of a Committee of the American Political Science Association appointed to study the improvement of national party organization also supported the need of a more disciplined party system: *Toward a More Responsible Two Party System,* American Political Science Association, 1950.

have as great a stake in democracy as any other segment of society and therefore cannot afford to let the political parties become unrepresentative and corrupt.

Pressure Groups. The role of agricultural groups in political activity is somewhat more difficult to spell out than agriculture's role in the party because agricultural groups constitute such a conglomeration of purposes and activities. Three problems, however, stand out: How many agricultural interest groups should exist to best advance the cause of agriculture? To what degree are agricultural groups actually representative of farm interests? And what should be the relationships of agricultural groups to the governmental process?

With respect to the first question, there has been a belief in some quarters that the proliferation of agricultural groups is detrimental to the best interests of farmers and that better policies and political effectiveness would result if the farmers' energies were not so dispersed among a large number of farm organizations.[13] Indeed there has been some feeling that what agriculture needs to develop most is integrated power that can compete favorably with the power structure of other segments of society.[14]

Neither a plethora of weak farm organizations nor the organization of all farm organizations into one monolithic structure, however, is in agriculture's best interests. On the one hand a large number and variety of farm organizations proliferates farmer participation in the formulation of policy and increases the number of ways in which agriculture can influence non-farm groups in the general political process. Conversely, the voice of agriculture can be lost in a maize of highly specialized organizations, nor is the existence of a large number of agricultural groups necessarily proof that agricultural policies are being democratically formulated.

What is desirable in agricultural organization is to keep a dynamic and pervasive group structure which at the same time does not impede the formation of general farm policies. Care needs to be taken that special interest groups do not dominate the general farm organizations or that the general farm organization do not suppress the minority point of view. It is more than likely, however, that with increasing economic specialization and proliferation of agricultural groups more emphasis will have to be placed in the future on strengthening farm organizations which are formulating general policies. Currently there is reason to believe that pressures of specialized commodity and program groups are becoming so strong as to obscure agricultural policy and are making political compromise with

[13] For an article which makes a case for a more unified farm front see Charles L. Stewart, "A Frontal Organization for American Agriculture," *Farm Policy Forum*, August 1952, pp. 23-26.

[14] Note for example the conclusions drawn in a book by J. K. Galbraith, *American Capitalism: The Concept of Countervailing Power*, 1952. See also the discussion entitled "That Controversial Farm Policy Report," *Farm Policy*, July 1952, pp. 6-25.

non-farm groups difficult. Organizations such as the Farm Bureau, the Farmers' Union and the Grange have a responsibility which the more specialized groups cannot undertake—to formulate agricultural policies reasonably representative of all farm interests and to interpret these policies to the rest of the political society.

The attainment of equitable representation poses another serious problem for farm groups. An impartial study of over-all membership in agricultural interest groups and associations would show that the wealthier farmers are better represented both in terms of numbers and influence than the less well-to-do agriculturists.[15] Of even deeper concern is the fact that the policy-making process within many agricultural groups is not fully representative of the membership. Farm organizations like to boast about grass roots participation but there is increasing evidence that farm organizations like labor unions and other large groups of our society do not have wholesome participation by the rank and file membership.[16] Moreover, the manner in which some agricultural groups have operated within their own organizations has caused them to be the objects of suspicion and criticism by non-agricultural groups with whom they must cooperate in the political process.

There is no sure way whereby agricultural groups can maintain a representative character. There are, of course, organizational and procedural checks which the membership may place upon the officers of a group, but these constitute only the form and not the substance of democratic policy-making. Pressures from the political parties and other groups can also aid in keeping the agricultural groups representative. But ultimately much depends upon the integrity of the farm leadership and the extent to which individual farmers understand and appreciate the importance of democratic processes in group organization. In this connection researchers need to pay far more attention than they have to the decision-making process that takes place in various agricultural organizations so that farmers can perceive the major shortcomings of the over-all agricultural group structure. As a political minority agriculture cannot expect to command maximum influence over other groups in the political process if the policies which it espouses have not been democratically formulated.

The involvement of agricultural groups in the governmental process

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[15] Classifying farmers by economic status into three categories, high, meduim, and low, a public opinion survey conducted in 1942 found that better than fifty percent of the farmers in the high economic bracket had membership in a farm organization, nearly thirty percent in the medium bracket claimed memberships, but less than fifteen percent of the low economic group were farm organization members. (*Public Opinion, 1935-1946*, edited by Hadley Cantril, Princeton University Press, 1951. p. 5.)

[16] One of the most illuminating studies of how policies are formed in a state farm organization is to be found in William Bruce Storm, "An Analysis of the Illinois Agricultural Association as a Pressure Group for Farmers" (Unpublished Doctoral Dissertation, University of Chicago, 1950).

is another problem which is being viewed with growing alarm by a substantial portion of the farm population. Many agricultural leaders are afraid that agriculture is losing its political freedom as a result of commitments and ties to administrative agencies and programs. They also see the new power blocs which have been formed by the bureaucracy and participating farmers around administrative programs as a threat to the status of bonafide farm organizations.[17]

The degree to which farmer groups should become involved in the governmental process will naturally vary with the political and economic situation and the nature of the program. However, in view of the farmers long participation in the development of administrative programs it is unlikely that they can afford any revolutionary shifts in existing relationships. Moreover, the degree of governmental involvement is less significant from the standpoint of agricultural group interests than are some other considerations. As has been previously pointed out, most important is that the administrative decision-making process should be kept visible no matter how or at what level it is exercised. Farmers and farm groups need to remember that the best guarantee against an unhealthy concentration of administrative power is to make the exercise of that power as public as possible.

Farm groups can also protect themselves against undue administrative bureaucracy by seeing that no more agricultural functions or responsibilities are placed at one level of government or in one agency than are necessary to formulate effective policies. By forcing administrative agencies to proliferate and decentralize the decision-making process, more political checks and controls can be brought into play.

Finally, farmers and agricultural organizations must remember that it is equally as important to view administrative agencies as vehicles for general public influence as it is to view them as objects for farmer control. Farm groups should therefore use tactics in administrative participation which will widen their area of influence particularly with non-farm groups. This means that farm organizations should not always press for solely agricultural representation or participation in an administrative program. By trying to acquire exclusive administrative jurisdiction farmers may win thereby the immediate struggle of program control but lose the more significant battle of general political support.

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[17] Some of the conflicts between general farm organizations and the government-sponsored agricultural organizations such as PMA and SCS are well traced in Charles M. Hardin, *Soil Conservation and the Struggle for Power in Rural America, op. cit.* The significance of the antagonisms are reflected in Hardin's conclusion that "the only effective challenge to [the Farm Bureau Federation's] monopolization of influence respecting major agricultural policies, at least, may be in the PMA committee system." p. 149.

NEEDED ADJUSTMENTS IN FARMING

R. P. CHRISTENSEN
Agricultural Research Service

The Surplus Problem

"SURPLUS" may be defined as more farm production than can move into market outlets at prices considered profitable to farmers. Existence of such surpluses points to the need for giving more attention to adjustments in resource use on farms, both to improve incomes of farmers and to make better use of resources from a national point of view. Realized net income of all farm operators from farming in 1953 was 7 percent less than in 1952, and 13 percent less than in 1951. The purchasing power of this income was less in 1953 than in any year since 1940. The reduction from 1951 to 1953 was due to a 15-percent decline in prices received by farmers without a comparable reduction in cost rates. Prices paid for production goods and services decreased only one percent. Lower prices for farm products resulted from a larger volume of marketings, higher marketing costs, and reduction in export demand.

The over-all surplus of farm production in relation to market outlets was equivalent to less than 3 percent of the total production marketed in 1953. In other words, with exports and imports of farm products as they were, a 3-percent increase in consumption or a corresponding decrease in marketings would have brought the average annual supply in balance with annual utilization.

Surpluses have arisen because of expansion in production and not from over-all reduction in market outlets. Marketing and home consumption of all farm commodities were 7 percent larger in 1953 than in 1951. Domestic use of farm products increased as total population rose 3.4 percent. This more than offset a decline in exports equivalent to less than 2 percent of total production. Costs of marketing farm products increased 4 percent or nearly 2 billion dollars from 1951 to 1953. The total value at shipside, including transportation and other marketing charges, of farm products exported decreased 17 percent or 1.6 billion dollars. Reductions in exports have been very large for certain products and they raise important adjustment problems for the farmers who produce these products.

It is pointed out frequently that with the growth in population expected in the next few years markets will be available for a total farm output as large as or larger than was produced in 1953. It has been suggested that farmers can improve their gross incomes over a period of several years by changing their farming operations so that marketings

will be smaller in the next year or two but larger in later years when total demand is greater. However, one cannot be certain that expansion in total production will not keep pace with expansion in total demand. If it does, many farmers might find that there is no advantage in transferring production into the future.

What happens to total farm output in the next few years will depend a great deal upon the factors that affect technology and inputs of resources in farming. Is there still an accumulation of improved production techniques which are profitable under current conditions but are not yet applied? May farmers be expected to adopt these and will they affect total farm output? Will increased use of resources such as fertilizer be so profitable that large additional output will follow? Will recent reductions in income affect investment capital available to farmers, slow down adoption of more efficient production techniques, and reduce expenditures for inputs of resources? These are questions on the supply side which, in addition to those on the demand side, need to be answered before it is possible to say much about prospective incomes from farming and needed adjustments in use of resources in the next few years.

Detailed study of the possibilities might show that total farm output is likely to continue to keep pace with expansion in markets. In that event one would expect little improvement in farm prices or in gross farm income even though general economic conditions remain good. Net incomes of farm operators from farming could be improved only if costs of production were reduced. But in order to reduce costs, it would be necessary to reduce inputs of resources. In this connection it is useful to think of resource inputs as in two categories: (1) Those for which farmers make cash expenditures annually and which originate mainly outside agriculture, and (2) those whose returns are represented by net income and which may be called "residual claimants." The latter category includes operator and family labor and the operator's equity in land and capital. Is it likely that smaller cash outlays for resources from non-farm sources will be profitable to individual farmers? If not, the only way in which total inputs and costs can be reduced is by transferring resources whose returns are represented by net income from farming. This would increase returns to resources in the "residual claimant" category which remain on farms. That is, total output might be brought into balance with total market outlets at a lower level of farm prices, and rates of return to resources in the "residual claimant" category might be improved if at the same time adjustments involving the transfer of some of these resources from farming were achieved. This would mean fewer farmers to share the residual income.

This paper is an attempt to indicate what we need to learn before it will be possible to say what kinds of adjustments in farm production will be needed in the next five or six years to improve net incomes of farmers and to make more efficient use of resources on farms. It brings together some of the relevant facts and suggests some of the answers. But perhaps most important, it points out the main gaps in our knowledge that will need to be closed before it will be possible to provide really adequate guidance in the development of farm production programs and policies.

Adjusting Total Farm Output

Small changes in supplies of farm products bring about much larger changes in farm prices and gross income. For example, prices received by farmers increased 18 percent from 1950 to 1951 when total production marketed plus imports declined 1 percent and domestic use plus exports increased 2 percent. On the other hand, prices declined 15 percent from 1951 to 1953 when production plus imports increased 7 percent and domestic use plus exports went up only 2 percent. Changes in farm prices would have been greater if it had not been for reductions in stocks in 1951 and additions to stocks in 1952 and 1953. Reductions in stocks were equivalent to about 3 percent of total production in 1951 while additions to stocks were equivalent to nearly 3 percent of total production in 1952 and 1953. It would be difficult, if not impossible, to stabilize total farm output from one year to the next or to adjust it upward or downward as total market outlets change between years and thereby avoid fluctuations in prices received for farm products. But it should be possible to influence the total volume of farm output over a period of several years and bring it into approximate balance with total market outlets at prices that might be considered profitable to farmers.[1]

Adjustments in the total volume of farm production that will be necessary in order to bring it into balance with market outlets at prices averaging about the same as in 1953 can be estimated, at least approximately. Looking ahead to about 1960, markets would be available for about 8 percent more farm products than were produced in 1953 if total population increases 10 percent as is expected (Table 1). This projection assumes little change in the total volume of imports and exports and no change in per capita consumption from 1953, but it does take into account accumulation of stocks in 1953. Of course, in order that farm prices average as high as in 1953 it would be necessary also that gen-

[1] Not all will agree with this. For example, one view is that total farm output will continue to increase rapidly, depending upon adoption of new technology and weather, and that it cannot be influenced significantly by educational or other efforts to bring about changes in total inputs of resources in farming.

eral economic conditions affecting per capita incomes and marketing costs be about the same as in 1953.

Market outlets for farm production in the next year or two will be affected by stocks now on hand. We have large stocks of feed grains, wheat, cotton, oilseeds, and manufactured dairy products (Table 2). For example, carry-over stocks of feed grains from previous years into the 1954 feeding year were equivalent to nearly 25 percent of annual production in 1953 as compared with 15 percent in 1946-50. Carry-over of wheat

TABLE 1. ANNUAL SUPPLY AND UTILIZATION OF AGRICULTURAL FOOD PRODUCTS AS PERCENTAGE OF 1947–49 PRODUCTION, SELECTED YEARS AND PROJECTIONS FOR 1960[a]

	Percentage of 1947–49 production[b]				
	1947–49	1951	1952	1953	1960
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
Production	100.0	99.0	104.0	105.8	114.3
Imports	6.8	7.5	7.5	7.7	7.7
Total supply	106.8	106.5	111.5	113.5	122.0
Domestic use[c]	99.5	103.1	103.2	105.4	116.0
Exports[d]	5.3	6.1	6.0	6.4	6.0
Change in stocks	2.0	−2.7	2.3	1.8	0
Total utilization	106.8	106.5	111.5	113.5	122.0

[a] Computed from data in "The National Food Situation," U. S. Department of Agriculture, Feb. 10, 1954, page 2, table 2. Projection for 1960 shows total production for which markets would be available if domestic use increases 10 percent with population growth, exports and imports are about the same as in 1953, and stocks do not change during the year.

[b] Data cover all agricultural products having food uses, including their nonfood uses such as feed, seed, industrial alcohol, alcoholic beverages, etc., and some waste and loss at the farm level, but exclude nonfood products such as cotton, tobacco, and shorn wool.

[c] Includes civilian and military food use and nonfood use.

[d] Includes commercial exports and shipments and net purchases for exports by the Department of Agriculture.

was equal to 50 percent of the wheat produced in that year as compared with 15 percent in 1946-50. Carry-over of cotton from 1953 was much less than in 1946-50 but it was about 60 percent greater than in 1952. For manufactured dairy products, stocks at the end of 1953 were equivalent to 9 percent annual milk production on farms as compared with 2.5 percent in 1946-50.

The magnitude of stocks of feed grains is indicated by the fact that if they were reduced to 1946-50 levels by moving them into consumption in the form of livestock products they would provide the equivalent of about 5 percent more poultry, eggs, and red meats at recent annual consumption rates. Of course, it would take time to convert feed grains into animal products, but liquidation of stocks to 1946-50 levels spread over a 5-year period would provide about 1 percent more poultry, eggs,

and red meats each year. Liquidation of stocks of dairy products would provide somewhat larger increases in per capita consumption. In order to reduce stocks of wheat and cotton, it would be necessary to reduce their production or to expand exports. Farm programs call for a reduction of about 25 million acres in wheat, cotton, and corn from 1953 to 1954. If all of this land were used for feed grains, hay and pasture, it would provide about 1 billion pounds of beef and veal each year or about 4 percent more of the red meats than was produced in 1953.

TABLE 2. CARRY-OVER STOCKS OF SELECTED FARM PRODUCTS[a]

Products	Unit	1946–50 average	1951	1953
Feed grains, total	Mil. tons	18.7	28.7	26.9
Corn	Mil. bu.	447	739	764
Oats	Mil. bu.	249	292	256
Barley	Mil. bu.	69	94	51
Sorghum grains	Mil. bu.	—	38	7
Wheat	Mil. bu.	223	396	562
Rice	Mil. cwt.	.8	2.2	.4
Cotton, running bales	Mil.	7.0	3.5	5.5
Milk equivalent, total	Bil. lbs.	3.4	4.8	11.0
Food fats and oils[b]	Mil. lbs.	411	590	1,589
Nonfood fats and oils[b]	Mil. lbs.	1,115	1,306	—

[a] Corn and sorghum on October 1, wheat, oats, and barley on July 1, rice on August 1 in Southern States and October 1 in California, cotton on August 1, dairy products at end of year, and fats and oils on October 1.

[b] Data for 1950 only shown in the 1946–50 column. Data do not include the oil equivalent of oilseeds carried over.

To the extent that stocks are reduced by moving them into domestic consumption in the next few years, market outlets for new production will not increase as rapidly as will growth in population. If this policy is followed, markets for a total volume of production larger than in 1953 will not be available until three or four years from now. In other words, market outlets for 8 percent more farm products than were produced in 1953 at prices about the same as in 1953 would not be available until as far ahead as 1960. Of course, there may be a sound basis for keeping larger stocks than in earlier years for such contingencies as crop failure or unusual foreign requirements.

Prospects for change in the total volume of farm output under general economic conditions described here are not definite. One view is that new and more efficient production techniques are likely to be developed and put into use so rapidly that total farm production will tend constantly to increase more rapidly than total population.[2] Another view is

[2] Willard W. Cochrane and Harlan C. Lampe, "The Nature of the Race Between Food Supplies and Demand in the United States, 1951-75," *This Journal*, May 1953.

that our stockpile of improved production techniques that remain to be applied is much less than it was some years ago. The possibility of obtaining additional output from this source is less than it was when we moved from the late 1930's into the early 1940's.[3] But changes in total farm output probably may depend more upon changes in inputs of resources than upon changes in technical efficiency of production. And changes in inputs will be affected by the general economic conditions that influence farm income and available farm capital as well as by the profitableness of using more resources on individual farms.

Since 1942 the total volume of resources used in farming has increased more than total farm output. The greatest improvement in the technical efficiency of farm production on record came in the period from the late 1930's to the early 1940's when the ratio of total farm output to total resource input increased at least a fifth.[4] In this period expanding market outlets at increasing prices for farm products were available and technological conditions apparently were such that additional resource inputs yielded large physical and economic returns to farmers as a group. Improved growing conditions also were important. The large additional inputs of resources in the last few years apparently have not yielded physical and economic returns as large as did those in earlier years. The more important development recently is the increased use of mechanical power, machinery, equipment and fertilizer. Increases in capital have been only partially offset by reductions in labor as total inputs have been increased.

One might conclude that little expansion in total farm output is likely to occur from additional inputs in the next few years if prices of products and resources average about the same as in 1953. However, this is not certain. The recent reduction in farm income and in the purchasing power of income may cause farmers to reduce their cash expenditures for machinery, equipment, building improvements, and other capital items. But probably they have mechanized their farming operations sufficiently so that they can handle a larger output without much additional capital investment and perhaps with less labor. Moreover, it may be that still larger cash expenditures for certain items are profitable to individual farmers. This matter is considered in greater detail later when the possibilities of managing resource inputs to reduce production costs are discussed.

Total farm output could be expanded greatly in a few years by using more resources in farming and better production techniques. The study

[3] Harry C. Trelogan and Neil W. Johnson, "The Evitability of Technological Advance," *This Journal*, November 1953.

[4] See Bureau of Agricultural Economics *Farm Production Practices, Costs and Returns*, U. S. Department of Agriculture Statistical Bulletin No. 83.

of agriculture's capacity to produce made in 1951 reports that a total farm output 20 percent larger than in 1951 could be attained within 5 years under certain assumed conditions (including a parity price ratio of 105 percent as compared with 100 percent in 1910-14).[5] It was estimated that this volume of output would be possible if farmers put into practice improved production techniques which would be profitable under the assumed prices for products and resources. However, this is not an estimate of how total output is likely to change under conditions which have developed as the parity ratio declined from 104 percent in 1951 to 93 percent in 1953. The capacity study shows how farm production could be expanded efficiently if markets were available for all that could be produced at the assumed prices. This study is extremely helpful in telling us how to obtain additional production to meet emergency requirements. But it does not tell us how total farm production or its composition needs to be adjusted during the next few years to bring production into balance with what now appear to be prospective market outlets at prices profitable to farmers.

Farm output probably will exceed the volume markets will take at 1953 prices in the next year or two even though general economic conditions remain favorable and normal growing conditions prevail. This is especially likely if some of the large stocks on hand are moved into domestic use. But before it will be possible to speak with much assurance about the future course of total farm output over a longer time, much more needs to be known about the factors that affect production on individual farms. Such information is needed in order to decide what the longer-term price and income prospects are for farmers. It also is needed to determine whether transfers of marketings from the transition period of the next year or two to a period four or five years from now, (such as are contemplated by shifts to more hay and pasture and livestock) really will be profitable to farmers and nationally desirable aside from other objectives such as conservation of soil resources.

Balancing Farm Production

Regardless of how total farm output changes in the future, some adjustments in output of different farm products will be needed. Supplies of some farm products have been much larger in relation to effective market demands than have supplies of others. This is the result of changes in export outlets in the case of certain crops such as wheat and cotton

[5] U. S. Department of Agriculture, *Agriculture's Capacity to Produce—Possibilities Under Specified Conditions*, Agriculture Information Bulletin No. 88, June 1952. Total farm output includes all production for human use in the current year whether or not the production is marketed and should not be confused with the index of total marketings and home consumption of farm products.

and changes in domestic outlets as in the case of milk produced in areas where it is used mainly for manufactured dairy products. But it also is the result of changes in conditions affecting production costs for different farm products.

The objective of adjustments to achieve better balanced production is to increase the gross value of farm production and thereby the net incomes of farmers. If we are to find market outlets for a larger total farm output by increasing per capita consumption rates, it will be necessary to shift the composition of total output to include more of the products for which demand is elastic and capable of expansion. This would involve more poultry, eggs, red meats, fluid milk, and vegetables and fruits, and less of certain other products such as cereals and potatoes.

Changes in production needed by 1960 to achieve effective use of resources on farms with a total volume of farm output about 8 percent larger than in 1953, a per capita consumption index about the same as in 1953, and exports of farm products a little smaller than in 1953 can be estimated approximately (Table 3). Total marketings of red meats would need to be about 6 percent larger than in 1953 or at least 20 percent larger than in 1951. Production of milk would not need to be ex-

TABLE 3. PRODUCTION OF SELECTED FARM PRODUCTS IN 1951 AND 1953 AND REQUIRED IN 1960 UNDER ASSUMED CONDITIONS[a]

Products	Unit	1951	1953	Required in 1960	1960 as a percentage of	
					1951	1953
					Percent	*Percent*
Red meats, total	Mil. lb.	21,908	24,857	26,400	120	105
Chicken and turkey meat	Mil. lb.	5,437	5,684	6,360	117	112
Eggs	Mil. doz.	5,433	5,680	6,140	113	108
Milk	Bil. lb.	115.3	120.5	121	105	100
Feed grains, total	Mil. tons	112.9	117.2	127	112	108
Wheat	Mil. bu.	981	1,163	1,040	106	89
Rye	Mil. bu.	21	18	21	100	117
Rice (milled basis)	Mil. cwt.	25	32	32	128	100
Dry beans and peas	Mil. cwt.	19.4	19.7	20	103	102
Potatoes	Mil. bu.	320	374	367	115	98
Sugar, raw basis	1,000 tons	2,042	2,360	2,360	116	100
Edible fats and oils	Mil. lb.	9,168	9,053	9,260	101	102
Inedible fats and oils	Mil. lb.	3,054	3,400	3,400	111	100
Cotton (running bales)	Mil. bales	15.1	16.3	14	93	86

[a] The quantities for 1960 would provide an index of total marketings and home consumption of agricultural food products about 8 percent larger than in 1953 and enough food for 176 million people at consumption rates about the same as in 1953 (as indicated in table 3 on page 28 of "Agricultural Programs of the United States, A Report to the Food and Agriculture Organization of the United Nations," U. S. Department of Agriculture, Nov. 1952) and exports smaller than in 1953 and as follows for major items: Wheat 250 million bushels, cotton 3.6 million bales, rice 10 million cwt., and edible fats and oils 1,000 million pounds.

panded as production has been in excess of market outlets and markets for manufactured dairy products may not increase much with population growth. However, considerable change in the location of production would be necessary to provide additional milk for utilization in fluid form. Production of wheat would need to be about 10 percent less and that of cotton about 15 percent less than in 1953 with exports of 250 million bushels of wheat and 3.6 million bales of cotton. In the case of sugar and wool, production needed would depend upon the quantities imported, but expansion in domestic production could be absorbed. Market outlets for fruits and vegetables probably would expand at about the same rate as population growth, or about 10 percent by 1960.

Additional supplies of feed would be needed to expand output of animal products by the quantities indicated. The total acreage in cotton and wheat might need to be about 10 million acres less than in 1953, and this land probably would be used mainly to grow feed grains, hay, and pasture. It may be noted that a cut-back in acreages of cotton and wheat as large as was sought from 1953 to 1954 may not be necessary over the longer term. This land probably would provide only about one-fifth of the additional feed required and at least four-fifths would need to come from land now used to produce feed. Yields of feed crops and pasture would need to be increased about 6 percent or about as much as in the last few years.

Admittedly, this is only a rough approximation of a production pattern which would make effective use of resources on farms. Exports, for example, may differ substantially from those assumed. A more complete analysis of prospective shifts in domestic demand and supply of the different products would be necessary for a more definite decision as to the changes that are likely to be desirable. Moreover, the production pattern would need to include even more of the products for which per capita demand is most elastic if supply conditions are such that it becomes necessary to move a larger total volume of farm products into domestic use. Nevertheless, the production pattern suggested here probably indicates the directions of desirable change. The needed shifts do not appear large, and it should be readily possible to achieve them provided the necessary economic incentives are established.

Managing Inputs of Resources

Thus far the discussion has been mainly concerned with adjustments affecting gross farm income. The gross value of farm products sold would be 8 percent higher in 1960 than in 1953 if total production marketed increases 8 percent under the assumed conditions—moderate change in the composition of production, total population rising 10 per-

cent, and general economic conditions that affect per capita incomes remaining about the same as in 1953. But net incomes of farmers are affected by changes in production costs as well as in markets. In 1953, realized gross farm income of farm operators was 35.1 billion dollars and production expenses amounted to 22.6 billion dollars, leaving a total realized net farm income of 12.5 billion dollars.[6] Therefore, if it were possible to expand production 8 percent and gross farm income 2.8 billion dollars by 1960 without increasing the total expenses of production, net income of farm operators from farming would be increased about 20 percent. To the extent that expenditures for production are increased by less than 2.8 billion dollars, net income of farm operators would be increased.

In order to shed some light on future possibilities let us consider what happened from 1910 to 1952 and more recently from 1942 to 1952. In each of these years the ratio of prices paid by farmers for production goods and services to prices received for farm products sold was close to 100 percent. Consequently, changes in net farm income from 1910 to 1952 and from 1942 to 1952 were due mainly to changes in the quantities of resources used in farming and in the ratio of total farm production to total resource use. They were not due to changes in prices of farm products as compared with prices of resources purchased. Farmers change their cash expenditures for resources, increasing or decreasing them, to improve their net incomes or returns from their labor and fixed investments. Therefore, we need to observe changes in use of resources for which cash expenditures are made as compared with changes in those with returns represented by net income. We also need to note how changes in the former have influenced returns to the latter.

Changes over the long term may be considered first. Total output per farm nearly doubled from 1910-14 to 1952 and the total volume of resources used per farm increased at least one-third and perhaps as much as two-thirds. Therefore, output per unit of all resources was 20 to 40 percent larger in 1952 than in 1910-14.[7] Total costs of farm production

[6] See recent issues of "The Farm Income Situation," U. S. Department of Agriculture.

[7] Estimates of how much total inputs of resources have increased vary depending upon the base period used to value inputs and how inputs of labor are counted. Index number series computed by Dr. Glen T. Barton of the Agricultural Research Service, and used by Dr. T. W. Schultz in *Economic Organization of Agriculture*, pages 107-109, shows that total inputs increased 14 percent from 1910 to 1950 when resources are valued at 1946-48 prices and 33 percent when resources are valued at 1910-14 prices. In both instances labor inputs since 1940 are based on changes indicated by the Bureau of the Census farm-employment estimates. However, earlier estimates published in *Farm Production Practices, Costs and Returns*, Statistical Bulletin No. 83, Bureau of Agricultural Economics, USDA, indicate that total inputs of resources increased about 40 percent since 1910. The total number of farms de-

increased, but there was a reduction in real costs per unit of output of between 20 and 40 percent. Use of resources purchased annually increased much more than those which are "residual claimants" and whose returns are represented by net farm income. This is shown by production expenses in 1910-14 compared with production expenses in 1952 deflated by the percentage increase in prices paid by farmers for production goods and services. Use of resources purchased annually by farmers increased 135 percent per farm (Table 4). The increase in total inputs of resources per farm consisted of items for which annual cash expenditures are made. In fact, it appears from these computations that use of resources per farm in the "residual claimant" category has declined slightly. This has been true despite some increase in the average size of farm. Technological conditions apparently were such that large cash expenditures for additional resources were profitable to individual farmers. They helped to make possible an increase of at least 60 percent in real output per unit of resources in the "residual claimant" category. And net income or returns to the "residual claimant" resources measured in real terms, increased nearly 60 percent per farm.

Changes in recent years differ from those over the longer term. Total input of resources increased at least as much as total farm output from 1942 to 1952. According to computations made here, total production and gross income per farm increased 22 percent while resources used per farm increased between one-fourth and one-third.[8] Thus, total production per unit of all inputs declined, perhaps as much as 10 percent, and total cost per unit of production measured in real terms has increased. Resources for which cash expenditures are made annually increased 36 percent per farm when measured in real terms (Table 4). Those in the "residual claimant" category and whose returns are represented by net farm income also increased. In this period farms decreased in total number and increased in average size. Net income per farm measured in real terms increased only 7 percent. Farmers apparently made large additional capital investments with the expectation that they would yield returns in the future large enough to cover these additional

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clined 16 percent from 1910 to 1950 so total inputs per farm increased at least one-third and perhaps as much as two-thirds. Index number series of inputs of resources in farming are now being revised in the Agricultural Research Service.

[8] The index series referred to in Footnote 7 based on 1946-48 prices for inputs which was used by Dr. Schultz shows that total inputs increased 7 percent from 1942 to 1950. In view of additional inputs in 1951 and 1952, the index shows an increase from 1942 to 1952 of at least 10 percent. The unrevised series computed by Dr. Barton indicates an increase of nearly 20 percent from 1942 to 1952. Therefore, if we take into account the 11-percent reduction in total number of farms between 1940 and 1950, the increase in total resources used per farm is at least 24 percent and perhaps as much as 35 percent.

TABLE 4. CHANGES IN PRODUCTION EXPENSES, NET INCOME, AND GROSS INCOME PER FARM OF FARM OPERATORS FROM 1910–14 TO 1952 AND 1942 TO 1952[a]

Item	1952 as percentage of 1910–14		1952 as percentage of 1942		Percentage of gross farm income		
	Actual	Deflated	Actual	Deflated	1910–14	1942	1952
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Current operating expenses	804	280	264	141	30	37	43
Farm-produced items[b]	1,195	420	278	141	9	16	19
Nonfarm items[c]	818	345	292	188	11	12	16
Hired labor	447	89	204	80	10	9	8
Current fixed items[d]	556	170	266	125	21	17	20
Total production expenses	703	235	265	136	51	55	63
Net farm income	426	157	187	107	49	45	37
Gross farm income	567	197	229	122	100	100	100

[a] Computed from data on farm income and production expenses published in recent issues of "The Farm Income Situation" and "Agricultural Prices," U. S. Department of Agriculture. Percentage changes in the deflated columns represent approximate change measured in real terms. They were computed by deflating 1942 and 1952 data by increases in prices paid for production expense items and prices received for farm products as shown by published index series.

[b] Feed, seed, and livestock.

[c] Fertilizer, operation of motor vehicles, and miscellaneous items.

[d] Depreciation, taxes on farm property, interest on farm-mortgage debt, and net rent to nonfarm landlords.

costs. They undoubtedly did on many farms. But for all farms as a group, total net income in 1952 was not large enough to cover additions to costs between 1942 and 1952 although they apparently were in several years prior to 1952 when the parity price ratio averaged above 100 percent. New investments have been influenced by other factors besides prospective economic returns.

Cash expenditures for production goods and services now are a large part of total costs of farm production. They were 63 percent of gross farm income in 1952 as compared with 51 percent in 1910-14. If cash expenditures for capital items beyond those required to cover depreciation are included, they amounted to nearly 24 billion dollars or about two-thirds of gross farm income in 1953. Only about 10 percent of the annual cash expenditures for production are in the relatively fixed category—interest on farm-mortgage debt, taxes on farm property, and net rent to nonfarm landlords. Nearly 90 per cent are in the relatively flexible category—cash outlays for new capital items, hired labor, fertilizer and lime, operation of motor vehicles, feed, livestock, seed, and miscellaneous items. Purchases of feed, seed, and livestock account for 30 percent of total cash expenditures for production items each year, but reductions in

these by some farmers would reduce incomes of other farmers. However, this would not be true of the other items, amounting to 60 percent of total cash expenditures, which come mainly from nonfarm sources.[9]

Cost Reduction?

Now turning to the future, what are the opportunities for making changes in resource use which will reduce production costs? The idea that it may be possible to improve farm incomes by reducing costs has wide public appeal. But like improving market demand for farm products by reducing marketing costs, it is not as easy as some may think. In order to reduce total costs and improve net income per farm when there is no change in market demand, it would be necessary to transfer some resources out of farming. In this connection, both over the long term and the recent past, total resource use and total costs of farm production have increased. Opportunities for reducing total costs may appear great now that cash expenditures account for such a large part of total costs.[10] However, reductions in many kinds of cash expenditures probably would reduce cash receipts and net incomes for individual farmers. For example, reductions in cash outlays for fertilizer probably would reduce production and thereby cash receipts more than cash expenses on most farms. Of course, now that prices of farm products have declined in relation to prices paid for production goods, returns from resources for which cash expenditures are made have decreased. This undoubtedly will influence expenditures for long-term capital investments, but it may not have much effect on operating costs.

These questions, What changes in cash expenditures are profitable to individual farmers? and What are likely to be the effects on farm output and resource use? are extremely important. The situation may be that still larger cash expenditures for resource inputs are profitable on many farms. For example, studies of adjustments in farming to take advantage of new technological developments generally show that large

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[9] As cash costs have increased in relation to gross farm income, net income is affected more by each percentage change in the ratio of prices paid for production goods and services to prices received for farm products than formerly was the case. For example, each 1-percent decline in prices received for farm products with no change in prices paid for resources for which cash expenditures are made brings about a reduction of nearly 3 percent in net income per farm at present as compared with 2 percent in 1910-14.

[10] The rise in cash costs also might be interpreted to mean that the total supply of farm products has become more elastic and that the opportunities for maintaining net incomes on individual farms by reducing costs and production as prices and demand for farm products decline have been increased. But this is not likely to be true as reduction in production on most farms will reduce cash receipts more than cash expenses.

additional capital investments for buildings, motor vehicles, machinery, livestock and other items would be profitable to individual farmers.[11] They show that unit costs of production could be reduced substantially but total production per farm would be greatly increased. Net farm income, returns to "residual claimant" resources, also would be greatly increased. If many farmers carried out such adjustments, total farm output would be increased much more than the prospective increase in total market demand. Nevertheless, they may represent nationally desirable changes in resource use. Whether or not extensive reorganization of farms takes place, such as is contemplated in these studies, will depend largely upon capital available to farmers and upon their evaluations of risk and uncertainty with regard to returns from additional capital investments and larger cash expenditures. This is a subject about which relatively little is known and concerning which much more needs to be learned in order to assess prospects for change in total farm output and net farm income. The studies of profitable adjustments in farming referred to above are a necessary first step, but additional analysis to determine the extent to which these adjustments are likely to be carried out and their effects on aggregate production, is necessary to decide what adjustments farmers as a group can make to improve their net incomes.

In view of the possibility that market outlets may be available for 8 percent more farm products than were produced in 1953 at 1953 prices by 1960 (under conditions described earlier), there is considerable scope for changes in production methods involving larger inputs of resources and larger cash expenditures which would expand total farm output without reducing average prices received by farmers. As long as an 8-percent expansion were achieved with less than an 8-percent increase in total resource input, average unit costs would be reduced. If it involved less than an 11-percent increase in cash expenditures for produc-

[11] Here are a few examples of findings, some of which have not yet been published: (1) In the Claypan area of southern Illinois use of capital to build up and maintain soil fertility and to establish livestock enterprises envolving new investments over a period of six years of $8,500 together with improved management practices could increase net cash income from $800 to $5,000 on a 185-acre farm. (2) In eastern Oklahoma conversion from a cotton-cash grain system to a dairy system would increase investment requirements from $6,500 to $12,500 and cash operating expenses from $1,500 to $3,700 but would increase family labor and management income by $2,000. (3) In central Nebraska if a farmer invested $5,000 to $8,000 in a pump irrigation system to irrigate 80 acres of a 160-acre farm properly organized, he would receive as much additional income as from an investment of $24,000 in 160 acres of additional dry land. (4) On dairy farms in southeastern Michigan adoption of improved practices and better cows together with large additional capital investments would more than double annual milk production, reduce unit costs by about 25 percent, and increase labor income more than threefold.

tion goods and services, net incomes of farmers as a group would be increased, and if it involved only an 8-percent increase in cash expenditures, net incomes of farmers as a group would be increased 8 percent. If conditions affecting total farm output are such that less than an 8-percent increase is in prospect by 1960, opportunities for making adjustments in farming to improve net incomes by adopting improved production methods which reduce unit costs would appear to be quite good, even though these adjustments might not reduce total costs or use of resources on farms, and might involve some additional production.

But there is the possibility that input of resources may increase or that production technology may improve so much that total farm production will expand more than total market demand. In that event, farm prices and gross farm income would be reduced even though total market demand were to increase, as described earlier. If this is the situation we face with developing technology and prospective markets, we need to know it now or very soon. It still would be possible over a period of several years to improve the average net incomes of farm operators. But in order to do so it would be necessary to transfer some resources whose returns are represented by net farm income, the "residual claimant" category, entirely out of farming. Such adjustments in resource use would not be easy to achieve. However, there would then appear to be no alternative way to improve efficiency of resource use and at the same time to improve net farm incomes. Farm programs and policies, including development of improved information about long-term prospects from farming, might well be organized to assist in making the needed adjustments.

PROPOSED NEW DIRECTIONS IN WORLD AGRICULTURAL POLICY

MORDECAI EZEKIEL
Food and Agriculture Organization

THE Food and Agriculture Organization of the United Nations, FAO, is both a parliament and a staff. As a parliament, representative agricultural officials of practically all nations of the world (other than those behind the Iron Curtain), from Agricultural Ministers and Secretaries down, assemble once every two years to debate the position of world agriculture and the policies their nations should follow over the two years ahead, and to establish the instructions and approve the budget for FAO's 1,100 men international staff. As a staff, the employees, under the Director General, provide member governments a central technical, economic and statistical intelligence service for the world's farms, forests, and fisheries, and aid the less advanced countries to improve their methods. In addition to the regular program with a budget of six million, they also administer FAO's sector of the U.N. "Expanded Technical Assistance Program" (ETAP)—amounting now to about five million dollars a year, with about 250 technical experts, drawn from 56 countries, at work in the less developed countries.

The Seventh Session of the FAO Conference, which met in Rome for three weeks in late 1953, marked a significant turning point in the history of the organization. This turn came just ten years after the idea of FAO was first discussed internationally at the Hot Springs Conference of 1943. Twice after the organization was formally established in 1945, its Director General had tried to obtain "action" powers to deal with problems of food surpluses—first under the World Food Board proposals of Sir John Boyd-Orr in 1946, and second under the International Commodity Clearing House proposed by Norris E. Dodd in 1949.[1] Each time the member nations refused to approve the proposal—though international consultative committees were set up.[2] The Council has become increasingly an administrative body, rather than a policy body as first conceived, especially since FAO headquarters were moved to Rome in early 1951 and the Conference sessions made biennial.

Both proposals, for the World Food Board and the I.C.C.H., were in a sense premature. Both were based on the assumption that the chronic

[1] *Proposals for a World Food Board*, July, 1946, iii + 12 pp.; and *Report on World Commodity Problem*, Dec. C 49/10, 73 pp. (Except as otherwise noted, all references in this article are to FAO documents or publications).

[2] *Report of the FAO Preparatory Commission on World Food Proposals*, Washington, Feb., 1947; and *Report of the 5th Session of the FAO Conference*, 1949, Washington, March, 1950, pp. 10-14.

pressure of agricultural supplies on demand, so familar in the "farm problem" of the late '20's and the "surplus problem" of the '30's, would reappear fairly promptly after World War II. The I.C.C.H., in addition, was supported by the actual fact of declining farm prices and temporarily increasing supplies during the slight U.S. industrial recession of 1948-49.

But rather than surpluses, food scarcities proved to be the characteristic feature of world agriculture in most of the first post-war decade. The one "action" power given to FAO was the power to ration short supplies under the International Emergency Food Council (and later the International Emergency Food "Committee"). This organization was brought under the FAO aegis in 1946 to continue under international auspices, the allocation activities which the Combined Food Board had carried on, under U.S.-U.K.-Canadian membership, as a war-time improvisation.[3] The I.E.F.C. operated through largely autonomous committees for each commodity, and its authority was limited to recommending export allocations to its member countries. Even so, it helped to even out the world's short food supplies over a considerable period, until the last commodity committee ceased its operations in 1949—and to some extent to prevent the short supplies from creating run-away prices on world markets.

At the same time that the I.E.F.C. was allocating the available food supplies, FAO as a whole was bending all its efforts to stimulating a rapid increase in world food supplies. Year after year the reports issued by FAO emphasized the short supplies of food, as compared both to the pre-war levels and to levels desirable for human nutrition; and the annual sessions of the FAO Conference adopted resolutions urging member governments to accelerate their efforts to increase food production, especially in the less developed parts of the world where food standards had always been low.[4] The 1951 Session of the Conference recommended "a well balanced increase" of world food production, of one or two percent per year faster than population growth, and urged member countries to support it by "preparing and carrying out forward agricultural plans suited to their own circumstances and conditions." In January, 1953, the World Rice Conference emphasized the expansion of world rice production and the increase of world trade in rice (still far below pre-war levels) as the key farm problem for the rice-consuming countries of Asia. Along with the world-wide resolutions, member nations were encouraged, and were assisted by the FAO staff, in the development of national programs for

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[3] *Report of the Special Meeting on Urgent Food Problems*, Washington, May 20-27, 1946, pp. 39.

[4] See 1st and 2nd *World Food Surveys* (1946 and 1952); *State of Food and Agriculture*, published annually beginning in 1947; and *World Food Situation* statements, published periodically from 1947 through 1949.

increased food production and regional meetings were held to examine these programs and aid in their integration.[5] FAO Technical Assistance activities from their beginning in 1951, were largely devoted to expanding food production.

The gradual success of these and other efforts to increase production were aided by the normal process of recovery from war, the vigorous help of U.S. funds and technicians to speed war reconstruction, and by the (much smaller) international investment funds supplied through the International Bank and Monetary Fund. With these efforts plus two years of generally favorable weather in 1952 and 1953, the general world food shortage came to a sudden end—not that all populations with low production and incomes had enough to eat, but that more food was offered for sale in international markets than could be disposed of at satisfactory prices.[6] Rationing and domestic food price controls had been gradually disappearing for several years, as food supplies became less severely short, and as the drive to abolish remaining war-time controls grew to a world-wide movement. But 1953 was marked by a reappearance of unwelcome "surpluses" in may exporting countries. Just as happened with World War I, food production during and after World War II expanded most rapidly and markedly in areas not directly damaged by the war; and this time, especially in North America. As food production in war torn areas was restored, the increased production elsewhere began to lose its new export markets and to become redundant.

In addition to the U.S., where large excess supplies started to accumulate in 1952, Canada found itself in 1953 with sizable increases in wheat supplies above export needs, though, according to the Canadian Government, these were not embarrassing. Turkey held wheat for a price she was unable to get, and found large supplies left on her hands and going out of condition. The major rice exporting countries of Asia, Thailand and Burma, had a similar experience with their expanded rice production; and Cuba in 1953 had cut back sugar output sharply as a result of accumulating supplies. Even the United Kingdom was faced with temporary surpluses of pork, necessitating sharp reductions of retail prices to encourage the public to consume above the previous rations. In France unsalable supplies of beef, wine, sugar, and other products developed forcing emergency measures to stimulate beef consumption, and to cut back pro-

[5] *Food and Agricultural Targets and Outlook for 1950/51*, Doc. C 49/23, 21 Nov. 1949; *Present and Prospective Development of Agriculture in Principal Regions*, Doc. C 51/23, 16 Oct. 1951; and *State of Food and Agriculture, 1953*, Pt. II, Longer Term Prospects.

[6] "Scarcity" is used here in the sense of the supply-demand situation, where demand means "effective demand." Nutritionists often confuse human needs with demand, and insist there is no surplus of food, even when large quantities are piling up, unsold and unsalable.

duction of other products after existing schemes for diversion into alcohol broke down under the volume being offered. Under pressure of increasing supplies, farm prices sagged in free markets in most parts of the world, both absolutely and relative to other prices, even with public price supports, continuing the movement which had started with the end of the Korean boom in mid-1951.[7] The United States began restricting the acreage of wheat, cotton, corn, and other products, and developing new measures to dispose of its extraordinarily large supplies.

The FAO Conference thus met in 1953 amidst greatly changed economic conditions. Director General Dodd, in his policy address to the Conference[8] faced the changed situation squarely but made no attempt to draw another rabbit out of the hat in the way of any new grand scheme to meet the problems. He recognized that the situation was in part the result of national measures with "prices guaranteed to farmers . . . at such levels that consumer or export markets will not absorb all the increased output at these prices . . ." and of flexible marketing structures which minimized the effects of declining farm prices in stimulating consumption. He suggested, as solutions to the situation:

"First, the emphasis on general expansion of food production, vital in the post-war crisis, must give way to a more selective approach. Production must be increased in the areas of greatest need, and in the commodities for which expanded consumption is needed and possible.

"Second, measures must be emphasized which will enable consumers to buy more of the foods now abundant. These measures may include increased purchasing power, reduced production costs, more efficient marketing including reduced distribution costs, and more flexible price policies.

"If we are to emphasize the selective approach, the effort to increase production must be pushed harder than ever in the under developed areas, and especially in the Far East. The two greatest needs are for large expansion in capital investment, and more technical assistance services. Efforts to place the technical knowledge of our experts at the disposal of these countries must be intensified."

With respect to the current surplus problems, he said,

"Now the situation appears to have changed. Surplus conditions have emerged at many points. In several countries domestic programs have been developed to dispose of surpluses accumulated through price support operations, while at the same time taking steps to reduce production. Other countries naturally have some fear of the possible effects of such surplus disposal operations on the markets for their own products."

"This situation, of concern to many members of FAO, is one in which FAO might help. Apart from their existing responsibilities to deal with formal international arrangements, you may wish to ask the Council and the Commodity Committee to give attention to the possible international repercussions of

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[7] See table and chart, *State of Food and Agriculture, 1953*, pp. 33-35.

[8] Statement by Norris E. Dodd to Commission I, 24, Nov. 1953 Doc. C/53/12.

domestic price and production policies, and to consider ways by which better coordination might be established between such national activities."

He also reiterated the long-term objectives of FAO, to see that all men everywhere had enough to eat, and urged that this should not be lost sight of in the efforts to deal with the possibly temporary current conditions.

Other papers before the Conference made similar recommendations, notably a brief report by a special international drafting group set up by the Council. This urged the Conference to consider measures along three lines; (1) the selective expansion of production, especially in the less developed regions; (2) maintaining the level of farm income, especially by increased efficiency; and (3) increasing per capita consumption.[9]

Commission I of the Conference is the group dealing with questions of world agriculture policy. It devoted nearly all its attention, over more than two weeks of discussion and debates, to these issues of economic policy. The discussions took place largely in two subordinate committees, one on selective expansion of production and consumption, and one on surplus and commodity problems, with representatives of all member countries participating. The resulting recommendations, after modification and approval by the Conference as a whole, appear as Chapter II of the final report of the Conference, including 11 specific resolutions.[10] In this short section (only 20 pages in the preliminary mimeographed edition), a new course is plotted for world agricultural policy with lines of national and international action laid out to achieve it as the unanimously agreed recommendations of the 71 countries present.[11] In addition, there are further recommendations on special action for individual commodities, which will not be considered here. The major aspects of the new course are as follows:

Selective Expansion of Production and Consumption

Since consumption has not been keeping up with production, future long-term policies and measures are to give as much attention to expand-

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[9] *Current World Situation and Outlook in Respect of Food and Agriculture.* Doc. C 53/5. Other background materials before the Conference included the printed document on the *State of Food and Agriculture, Part I;* another document summarizing and appraising national programs for agricultural production up to 1956/57, around the world, *State of Food and Agriculture, Part II, Longer-Term Prospects,* Doc. 53/10/8046); the report of the Committee on Commodity Problems (Doc. C 53/7, 14 pp.); and detailed commodity reports surveying the situation on each commodity.

[10] *Report of the Seventh Session of the Conference,* Rome, 1953, pp. 7-60.

[11] Practically every major and minor country of the world is now a member of FAO, execept the USSR and the other countries dominated by it. (Of these, China, Poland, Czechoslovakia, and Hungary were all charter members, but have subsequently withdrawn.)

ing consumption as to expanding production. In the less developed countries, some food surpluses have appeared even though consumption is still at very unsatisfactory levels. Special attention is therefore to be given to the possibilities of emphasizing expansion in production of those products most needed to improve the quality of the diet, to those best suited to diversifying each country's agriculture advantageously, and to means of expanding the levels of consumption. In the more highly developed countries and in commercial exporting regions, full attention of course must be given to market and demand prospects, both domestic and foreign, including the rate of increase in national income, buying power, and demand, and to the market situation and prospects for each commodity. In both groups of countries, much attention is to be given to raising levels of consumption by improving distribution, reducing marketing costs, making products available to consumers at lower prices through more efficient production and marketing, and expanding special feeding programs.

To implement these recommendations, all member countries are requested: to re-examine and revise their long-term agricultural programs; to devise specific measures to carry the revised programs into effect; and to report to FAO the measures taken. The staff of FAO is to assist governments of the less developed countries to work out those revisions in their programs. This will be done both through staff visits to individual countries, and through organizing regional consultations on the new programs to facilitate regional coordination of national policies. Three such meetings are to be held in 1954 for preliminary discussions of progress along these lines, in Latin America, the Near East, and the Far East, and more formal meetings in the three regions again in 1955.

To assist countries in the new task of "selective expansion," the Conference spelled out criteria for selective expansion under four heads: future domestic requirements, production potentials, economic considerations, and social and other non-economic considerations. Specific steps and measures were also suggested for encouraging increased consumption through improving marketing arrangements and lowering distribution costs. It also indicated in some detail how national governments and international organizations might encourage and assist farmers to put the new programs into effect. This included, for national action, measures dealing with education and information (extension), provision of credit, price policies, production requisites, storage or marketing facilities, production goals by provinces or countries, financing development, production controls and marketing regulations, and storage and disposal operations. The measures which international agencies might use, necessarily much less extensive, were directing technical assistance projects, so far

as possible, to "those which best fit the needs for selective expansion," and directing investment funds (not only from the International Bank, but likewise from regional or national organizations such as the Colombo Plan, colonial development funds, and the Export-Import Bank), along similar lines. Under each measure, reference could be given to projects or commitments in line with the new policy and objectives.[12]

It is too early to judge what effect these recommendations will have upon future agricultural production or food consumption. Governments are just starting to re-examine and revise their agricultural and food programs in line with the recommendations. Those revisions should result in more attention to market needs and trends, to the position of buyers both in domestic markets and in foreign markets, and to the need of expanding consumption as well as production. In the past, some countries have tended to have wide swings in production policies from year to year. The recent extreme changes in jute acreage and production in Pakistan are an example, with acreage in 1953 cut to only 40 percent of that in 1952. For such commercial crops, careful consideration of possible future trends in consumption, as well as of recent price and supply changes, may provide a somewhat longer range basis for production plans and result in less extreme variations from year to year. In those less developed countries where much of current food production is consumed directly by producers on their own farms, simultaneous consideration of production and consumption goals and measures may result in definite education drives to encourage farmers to raise their own consumption levels, proverbially low in the basic essential of calories alone. This may be especially important for foods such as rice, which previously have been scarce and now are becoming somewhat more abundant. As the calorie objective begins to be reached, increased attention also should be given to emphasizing expansion of food production and consumption for pulses, vegetables, and other potentially available foods most needed for improving the quality of the diet with respect to the scarce essential items—good protein, minerals and vitamins.

To some extent, the new emphasis on "selective expansion" may mean that many other countries will be encouraged to develop the same kind of agricultural programing and action that has gradually evolved in the U.S. during the first half of this century, and which has been widely developed by western European countries during and since the war. This includes programing commercial crops and products with careful consideration of market trends and future possibilities; planning for food production and consumption with full recognition of modern nutritional knowledge and

[12] "Selectivity in Policies for Food and Agriculture," *Monthly Bul. of Agri. Econ. and Stats.*, Vol. III, No. 2, Feb. 1954 pp. 1-6.

farm potentialities in the light of scientific discoveries; and following up the plans with measures adequate to secure the cooperaton of farmers in reaching the objectives mutually agreed upon.

Ultimately, of course, the problem of price will have to be faced—how high can prices be established or guaranteed to encourage production without being so high as to discourage consumption; and (alternatively) how much can and will countries devote from other resources, to subsidizing a higher price to producers than is paid by consumers, domestic and foreign? After everything is done that is possible toward stimulating consumption and directing production into the most desirable lines, the issues must also be faced as to where and how far production will have to be regulated, limited, or reduced by public action, as a last resort. These issues express some of the underlying dilemnas that bedevil current proposals for revising U.S. agricultural policies, as well as those of many other countries.

Short-Term Commodity and Surplus Problems

On the more immediate problems the Conference discussed international commodity agreements as one line of action to assure producers more stable prices. Despite the developments toward a new Sugar Agreement, progress in using international commodity agreements to ensure stability and assure returns to producers has been slow and unsatisfactory. While much discussion was devoted to reasons why this was so,[13] no steps to encourage more rapid action on this front were taken, except for agreeing to have a world rice conference in 1954 to survey the rice situation, if the Commodity Policy Committe found it feasible.[14] Since "some aspects of national policies have important effects on the economies of other countries (which) . . . tend to be particularly pronounced in periods of contracting markets," the FAO staff and the C.C.P. were directed to give special attention to the international effects of national agricultural policies and to promote international discussions, regionally or world-wide, which "would facilitate the adjustment of national policies to each other and the conclusion of agreements." The major commodity discussion, however, was given to the disposition of current surpluses, and

[13] *Inter-Governmental Policies and Arrangements for Agricultural Products,* Doc. C 53/9, 17 pp.

[14] The major issue this meeting might face would be the failure of rice consumption to increase in 1953, despite the larger supplies. The rice-importing countries used their larger domestic production to reduce rice imports rather than to expand consumption. The exporting countries, especially Burma and Thailand, were left with increased exportable stocks on hand. The situation was aggravated by the unwillingness of the exporters to reduce their prices in line with increased supplies. It remains to be seen whether the major countries concerned will be willing to include this ticklish problem, of international trade and prices, on the agenda of the coming meeting.

especially to the question of how surpluses could be disposed of by one country without upsetting world trade or damaging markets for other countries. The great U.S. surpluses, the hundreds of millions of dollars already appropriated by Congress for moving them, and the still larger schemes under discussion, were strong in the minds of many of the country representatives. The FAO Conference thus provided a forum where other nations could express their anxiety over how far the U.S. surplus disposal program actually would operate without harming them, despite the strong pledges made by the U.S. in all its relevant policy statements and legislation.

The Agricultural Minister of The Netherlands proposed that FAO convene a world meeting of agricultural ministers to discuss such issues. It was fully agreed, however, that a more modest initial approach would be more useful. Three steps were agreed on, as follows:

1. It was recommended "that Member Governments which have excess stocks of agricultural products should dispose of such products in an orderly manner so as to avoid any undue pressure resulting in sharp falls of prices on world markets, particularly when prices of agricultural products are generally low; and that where surpluses are disposed of under special terms, there should be an undertaking from both importing and exporting countries that such arrangements will be made without harmful interference with normal patterns of production and international trade."

2. The Committee on Commodity Policy (C.C.P.) was directed to set up a subcommittee on the problem of surplus disposal, to meet in Washington early in 1954, "to consider the best means of disposing of agricultural surpluses and the establishment of the necessary safeguards," and to circulate its report to governments ahead of the June meeting of the C.C.P. Further meetings of this sub-committee in Washington in 1954 and 1955 were also authorized, if found necessary. This subcommittee, composed of experts sent by eight countries met in Washington in late February. Its task was to recommend international standards for future surplus disposal operations, and perhaps to consider a series of further meetings at which specific surplus disposal proposals can be checked currently against the standards, once these have been agreed to by governments. Providing an international forum in which representatives of governments concerned can currently discuss any difficulties or irritations which are arising from current or proposed disposal operations, would help to minimize their international effects on regular commercial markets.

3. In addition to the rice and surplus meetings, the C.C.P. also was authorized to set up international sub-committees or working parties on other subjects or commodities as the occasion warrants.

Auxiliary Steps

Besides the specific actions on selective expansion and surplus disposal, the changed economic situation was recognized as many other places in the report of the Conference, and was reflected in a number of specific recommendations in support of the new policies. The recommendations to governments on providing better government services for agriculture, both for research and extension (Resolution No. 10), included:

"as an aid to the selective expansion of production and encouragement of consumption, also give special consideration to the development of those economics services which are necessary and desirable as agriculture progresses, including economic intelligence and market news services."

References were also made to developing the program of technical assistance to governments in line with economic conditions, as follows:

"Provision should be made within the Organization, subject to budgetary limitations, for more effective economic and financial appraisal of all FAO/ETAP projects, so that those projects may be selected with the greatest prospect of contributing to the general economic development of recipient countries . . .

"The Conference noted the technical assistance rendered in the field of programing for agricultural development and endorsed the importance of continuing this activity on a selective basis. Special help should be given to less developed countries in evolving their agricultural development programs and projects on a sound and realistic basis, taking into account not only technological but also the financial and economic aspects."

In connection with appraising the possibilities of expanding consumption, the Director General was requested to ask other international organizations to help in appraising the prospects for general economic development in various countries and regions, and to supply this information for the use of member countries and FAO bodies "in considering or drawing up programs for the selective expansion of agricultural production and consumption." (Resolution No. 7.)

In adopting an increased regular budget for the Organization the Conference added specific items to cover the regional consultations on selective expansion, the rice meeting, and the meeting on surplus disposal problems and other C.C.P. working parties.[15]

Looking to the Future

Steps to put the new policies into effect are actively under way in FAO. Teams of staff members are visiting countries in Latin America

[15] Mr. Dodd requested an increase in the budget from $5¼ millions for 1953 to $6,040,000 for 1954 and $6,200,000 for 1955. The Conference approved a flat six million for for each year.

and the Near East to help them in starting the re-examination and revision of their agricultural programs on a selective basis, with agricultural economists, agriculturalists, and nutritionists, all cooperating. The subcommittee on surplus problems met in Washington in February, and considered an intensive staff study on problems of surplus disposal.[16] It agreed on a recommended set of principles to guide countries in such disposal; and recommended the creation of a continuing intergovernmental consultative committee in Washington to meet at least monthly.[17] Preparations are under way for the three meetings for regional consultations on selective expansion during the second half of 1954, and for the rice conference, subject to C.C.P. approval at its June meeting. Technical Assistance projects are being considered with reference to their relation to the new policies.

The current world commodity situations themselves do indicate many variations among different commodity situations, and many possibilities of a more discriminating approach in production planning. As shown by the commodity summaries placed before the surplus meeting,[18] cocoa and coffee continue in chronically short supply; wool supplies are in fair balance with current demand; and there is at present no great pressure from surpluses of feed grains and forage crops, though stocks of the former have been increasing recently and corn is now under acreage control in the U. S. In sugar, the Cuban production adjustments are reducing the pressure of supplies, and the new Sugar Agreement, if finally ratified, may keep the situation in balance. Stocks of rice have been accumulating in some exporting countries, owing largely to price disparities, but some price concessions and export sales have been made recently. Surpluses are most evident and acute in wheat; in crops affected by increasing competition from synthetic substitutes (cotton, linseed oil, and rubber—and also butter in competition with oleomargarine); in raisins and currants, and in some types of tobacco. Some edible oils are also in surplus. Moreover, food production per capita varies widely from region to region, with the great increases in the best fed regions incapable of correcting to any material extent the inadequate supplies in the less developed regions, especially in the Far East. (Note Figure 1.) Both commodity-wise and area-wise, there are thus ample opportunities for the more selective approach recommended.[19]

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[16] *Disposal of Agricultural Surpluses,* Doc. CCP 54/1, CCP/SD/1, 8 Feb. 1954, 152 pp.

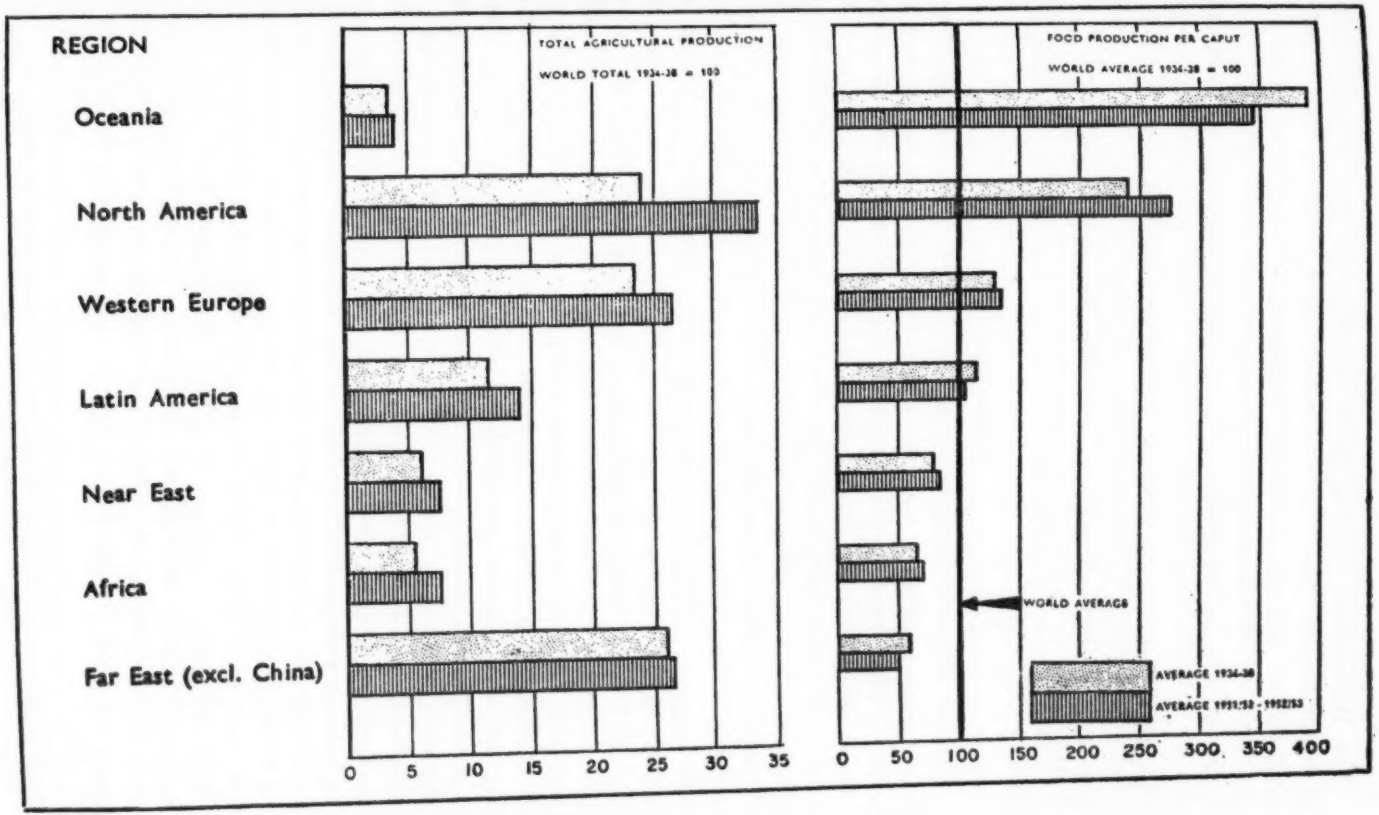
[17] *Report of Working Party on Surplus Disposal,* Doc. 225 54/2, 20 March 1954, 23 pp.

[18] *Disposal of Agricultural Surpluses,* Doc. CCP 54/1, CCP/SD/1, 8 Feb. 1954, 152 pp.

[19] *State of Food and Agriculture 1953.* This is based on data for the 1952/53 crop year; data for 1953/54 would change this situation only slightly.

FIGURE 1. RELATIVE MAGNITUDE OF WORLD AGRICULTURAL PRODUCTION AND OF FOOD PRODUCTION PER CAPITA BY PRINCIPAL REGIONS, 1934-38 AND 1951/52–1952/53 AVERAGES

FIGURE 1. RELATIVE MAGNITUDE OF WORLD[1] AGRICULTURAL PRODUCTION AND OF FOOD PRODUCTION PER CAPITA BY PRINCIPAL REGIONS, 1934-38 AND 1951/52–1952/53 AVERAGES



[1] Excluding Eastern Europe, U.S.S.R. and China.

The Washington working party on surpluses gave special emphasis to economic development in underdeveloped countries and to welfare programs as desirable outlets for surpluses, drew up a set of proposed standards for international surplus disposal to prevent upsetting international markets, and recommended a continuing international consultative group at Washington to meet monthly.[20] These recommendations were subsequently approved, with the consultative meeting open to all interested governments.[21] These activities, of course, relate only to the short-time surplus disposal problem, while the longer-time problems of preventing gluts or shortages are treated in the other activities described earlier.

Conclusion

Citizens of the United States, concerned with the problems of their own great continental country, often lose sight of the tremendous impact which even slight variations in U.S. conditions or policies may have on the welfare of other countries. The discussions of the 1953 FAO Conference gave agricultural representatives of other countries their first opportunity to express and debate their concern over the effects which recent developments in American farm and food policies might have upon them, and to start developing a longer-range and world-wide approach to the underlying difficulties. The FAO surplus disposal discussions in Washington may not make much difference in the way the U.S. actually carries through the enormous job of whittling down its stocks. But those periodic discussions should at least help both to allay irritations and suspicions of other countries as to the wisdom of the way the U.S. program is being developed and operated, and to keep those handling the program for the U.S. aware of its possible international repercussions. By calling public attention to some of the obdurate and continuing difficulties of the U.S. farm programs, the discussions may contribute somewhat to willingness of the groups involved to develop a real solution to them. Similarly, the redirection of farm production under the "selective expansion" resolutions and activities cannot be expected to produce any radical change in the way the countries of the world adjust to the changed and changing agricultural conditions. What it can do is to contribute some central concept of objective and independent appraisal and rational analysis as a basis for decision and action, and of close and friendly international consultation as an aid to such development. Emphasizing such tasks is the next phase in FAO's continuing search for food enough for all people, and prosperity for all farmers.

[20] Report of the Working Party on Surplus Disposal to the FAO Committee on Commodity Problems, CCP 54/2, 20 March 1954, 23 pages (mimeographed).

[21] Report of the 23rd Session, Committee on Commodity Problems, June 1954.

DEMAND ANALYSIS FROM THE M. S. C. CONSUMER PANEL*

G. G. QUACKENBUSH
Michigan State College

THIS is a report on the early progress of the M. S. C. Consumer Panel. The content of the paper includes a brief introduction to the panel, with a few statements on the objectives and justification for the project. There is a discussion of the sampling procedure, followed by some results in trying to evaluate the representativeness of the panel sample. Reliability of the panel data is given brief consideration. Following this are a few statements on operating procedures. A listing is made of some of the preliminary findings on the demand analyses which have been attempted. Finally, there are a few paragraphs on the potential of the panel as a source of data which are supplemental to traditional demand analysis.

The M.S.C. Consumer Panel consists of about 250 families which each week provide considerable detail on their food purchases. Each family reports the quantity, price, and expenditure for each food item purchased during the week. In addition, each family reports its income, expenditure and number of meals away from home during the week, and number of guest meals served in the home.

The first food purchase diaries of the panel were received in February, 1951. Since mid-summer of 1951, between 200 and 255 diaries have been returned by panel members each week. The sample area to date has been the city of Lansing, Michigan. The project, which supports the panel, was approved in late 1948, and was designed to continue for ten years.

The types of analyses that were originally intended may be illustrated by the objectives of the project. The first is to determine the effect of price changes (both real and money) upon the quantities of foods purchased, and the associated time-lag in adjustment. The second objective is to determine the effect of a change in income (both real and money) upon the quantity purchased and expenditure for various food products, and the associated time-lag. The third objective is to measure the effect of price changes and income changes upon substitution among different products. In a sense, therefore, the objectives are to determine price elasticity, income elasticity, and cross elasticity of demand.

The rationale of the project may be stated as follows: Many surveys have established certain relationships among different sectors of the population at a point in time, and many studies of time series data pro-

* Journal Article No. 1594 of the Michigan Agricultural Experiment Station. A revision of a paper presented at the joint meeting of the American Statistical Association and the American Farm Economic Association, Washington, D. C., December 30, 1953.

vide aggregative relationships over time. But, problems arise in explaining changes in aggregates without a knowledge of the component parts. Also, different sectors or the component parts may not respond over time as they would be expected to, based on relationships at a point in time. A second underlying reason for the project involves the time-period for which most consumption data are available, namely annual data. Responses to year to year changes may not represent the responses to which producers and marketers must adjust in many of their week to week and month to month activities. Many researchers in demand analysis have expressed the need for cross-sectional analyses over time and for short-period data.

The Sample and Its Representativeness

At the inception of the project it was found that no academic or commercial organization was collecting data by means of a consumer panel for purposes of what might be called traditional demand analysis. There were, however, many organizations which had set up systems to receive periodically various types of information from the same sources. These "panels" ranged all the way from public opinion polls to food purchase panels. Contact with 62 of the 68 known organizations provided assistance on problems of sampling, communication, incentives, diary construction, reporting periods, and tabulation methods. Besides this assistance some fairly intensive original research was conducted, particularly in the areas of bias due to non-cooperation and diary construction. Dr. James Shaffer has taken the leadership in these, as well as several other aspects of the project.[1]

The sampling procedure presented unusual problems. No scientifically tested means by which to maintain a representative sample over time was found. Also, the characteristics of the Lansing population were not well known, since the Census of 1940 was ten years old. It was decided to take a sample census. It would give a picture of the Lansing population, but perhaps the greatest usefulness would be as a pool from which to substitute for prospective panel members who refused or panel members who dropped. It was determined that a sample of approximately 2,000 families, or about seven percent of the population, would provide an adequate level of reliability, and at the same time provide an adequate pool for substitution. The sample was drawn systematically by selecting every fourteenth residential address from the street and address section of Polk and Company's Lansing City Directory. A total of 1,885 interviews were successfully completed.

[1] James D. Shaffer, "Methodological Bases for the Operation of a Consumer Purchase Panel", unpublished Ph.D. thesis, Michigan State College, 1952.

The 1,885 households were used as the basis for the panel sample. The original panel sample was drawn as a miniature of the sample census, using four control factors—income of the household, number in the household, age of the housewife, and education of the housewife. A panel with a potential of 300 members at any one time was agreed upon. The panel, therefore, equals about one percent of the population. In an attempt to keep the panel representative over time, a method of making substitutions for "refusals" and "drops" has been designed. In making substitutions eight controls in addition to the four mentioned above are used. There is also a procedure for keeping the panel representative of the current population so that families which cease to exist and those which move from the sample area are replaced by newly created families and families moving into the sample area. A new sample census will be taken in 1954 and every second year thereafter. The sampling technique is discussed in greater detail in a note in THIS JOURNAL.[2]

The degree to which the current panel represents the Lansing population may be judged to some extent by certain criteria. The average age of housewife, education of housewife, and size of family of the Lansing population likely haven't changed much since the sample census was taken in 1950.[3] Among these factors the averages of the current panel are about the same as the averages of the 1950 sample census. Incomes, on the other hand have changed. The only local income data available are gross weekly earnings of manufacturing workers in Ingham County, the county which contains Lansing. From the last half of 1951 to the first half of 1953, these gross earnings increased 21 percent. On the other hand, disposable income of panel members increased 16 percent in this period. Considering the increase in income taxes, the lag in increased income of white-collar workers, and other factors, these two figures may be quite comparable. Comparisons, using other criteria, can be, and should be made in the near future.

Panel data may be compared with national data. In the period 1949 to 1952 national per capita disposable income increased by about 20 percent. Comparing the average household disposable income in 1949 as reported in the sample census of 1950 and the 1952 income of current panel members, there also was a 20 percent increase in disposable income. The average size of family in the panel equals the national average for the urban population.

According to the Census of 1950 Lansing incomes were higher than the

[2] James D. Shaffer, "A Plan for Sampling a Changing Population Over Time", *This Journal*, Feb., 1954, XXXVI: 153-163.

[3] Thomas N. Moss, "Some Relationships of Selected Socio-Economic Factors to Food Consumption and Expenditures, Lansing, Spring, 1950", unpublished Ph.D. thesis, Michigan State College, 1952.

national average for the urban population. That is, the median family income in Lansing was 19 percent above the median in the United States. This city was quite different with respect to percentage of non-white persons. The percentage was 3.3 in Lansing compared with 10.1 in urban United States. Among many other characteristics dissimilarities were not great, however.

The panel will provide an opportunity to study groups of families representing specific segments of the population. It is likely that results of these studies will have applicability outside of Lansing, in some instances greater than results from the whole of the panel.

One more aspect of the sampling problem should be interjected at this point, namely, the amount of continuity of participation so that continuous records of a fairly large number of families are available over time. Continuous participation is defined as missing not more than two weeks in the time period. This distribution for the week ending October 24, 1953, when there were 255 active panel members follows:

More than 2½ years	50
2 to 2½ years	38
1½ to 2 years	37
1 to 1½ years	27

There were, therefore, 152 who had been in the panel for more than one year without missing more than two weeks; and 123 of the 152 hadn't missed any weeks in more than a year. Therefore, there appears to have been enough continuity among individual panel members to make certain types of analyses on the same families over time.

Reliability of Panel Data

An attempt to check the reliability of panel data has been to compare prices for different products as reported by the panel with prices reported in another, but well accepted, price series, namely the B.L.S. series in Detroit. The panel prices used for each product were the weighted averages for the week in which the 15th of the month fell. Six products have been tested, and the time period was the 21 months from April, 1951, to December, 1952.

Four of the products were fats and oils. For butter, the 21 month mean of panel prices was 5.3 cents per pound below the Detroit mean. The difference between the means was highly significant. On the other hand the coefficient of simple correlation of the two price series was .96, and the regression coefficient of 1.044 was not significantly different from 1.00. In other words, there was a wide spread between the two price series, but they moved up and down together over time. Although a price spread of 5.3 cents seems high, the parallel movement provides some faith in the

panel series. Among three other fats and oils products similar observations are noted. For margarine there was a price difference of 2.9 cents, for lard 1.5 cents, and for vegetable shortening 6.9 cents. The coefficient of correlation was .91, .90, and .89 respectively.

The only two meat products for which price comparisons have been made are hamburger and pork chops. In the case of hamburger the difference between the mean prices was only one-tenth of a cent, and the coefficient of correlation of the two price series was .94. The price series are not strictly comparable, however, since the Lansing price includes such things as ground round steak, and the B.L.S. series does not. The average price of pork chops in the Detroit series was 13.9 cents above the Lansing panel price, and the coefficient of correlation was .82. The B.L.S. series specifies center cut pork chops of No. 1 grade, and excludes soft or oily pork. The Lansing series includes all pork chops.

In comparing the panel and Detroit prices it is recognized that the B.L.S. series quotes prices of products of specific qualities, and quite often the products are of very high quality. In fact, these comparisons suggest an hypothesis that the qualities specified are above those actually purchased by the bulk of the consumers. One would not, therefore, expect perfect correlation over time even if both series were measured without error. In addition, the B.L.S. secures prices the first three days of the week when few of the groceries are bought. They miss the specials, coupon sales, and so forth, which do not occur at random. For this additional reason there would be differences in the two price series. Nevertheless, it is gratifying to us that panel prices have moved over time as closely to the B.L.S. prices as has been illustrated. Prices of more products should be subjected to this scrutiny in the near future.

Another check on the reliability of the data was to compare the distribution of food expenditures among different groups of products as reported by panel members with national estimates. Here again the results were quite satisfactory, with dairy products 17.6 percent, fats and oils (including butter) 4.9 percent, fruits and vegetables 18.3 percent, meat, poultry, eggs, fish and sea food 33.5 percent, cereal products 11.8 percent, beverages 7.5 percent, and all others 6.4 percent of total expenditures for food at home by panel members.

Some Operational Procedures

The incentive payments to the panel members range from five cents to fifty-five cents per diary, with the greatest premium on the length of time diaries are returned without interruption, but with some premium for promptness and for returning diaries in the summer time. The maximum that any member can earn, therefore, is $27.60 a year.

The diary used in the M.S.C. Consumer Panel may be characterized as

follows: (1) The reporting period is seven days; (2) it is a fairly completely itemized type where many foods are listed, in contrast to a journal-type where no products are listed or a class-heading type where only the names of major food groups are listed; (3) the person who keeps the diary writes in the quantity, price, and expenditure for each food item purchased during the week and either writes in or checks the other aspects of the product in which we are interested (for example, the brand and distribution method for milk, the method of preservation of fruits and vegetables, the grade and size of eggs, and so forth); (4) each family reports its disposable income each week, its number of persons, its number of meals away from home, the expenditure for meals away from home, and the number of meals served guests at home each week; and (5) the diary is intended to include all food items, in contrast to selected food items. Purchases of about 500 different products can be entered in the diary, and this is meant to include all products that can be purchased for home use.

Tabulation of the data is done almost exclusively by I.B.M. equipment. Nearly a million I.B.M. cards are used each year. This equipment is used to derive the price, quantity, expenditure, income and other data. Tabulation methods were not developed until there was some accumulated knowledge on the success of the sampling plan, the continuity of membership, and the methods of reporting. Consequently, although the panel has operated for three years, data have been available for analysis for only about one year.

The discussion on sampling, the diary, and operational procedures is a prerequisite to further discussion on what we are doing and plan to do in the near future to fulfill the objectives of the project.

Price Elasticity

In the area of price elasticity, four items are discussed: (1) the types of data that are available for analysis; (2) some of the questions that arise concerning the interpretations of the available data; (3) some problems in handling the data; and (4) plans for the future.

The price series that is currently being calculated for dairy products, fats and oils, meats, poultry and eggs, and fish and sea foods is a weighted average price, total expenditure divided by total quantity for each week. There is a price series for each product, i.e. pork chops, and for the respective product sub-group, i.e. pork (other examples: Homogenized Vitamin-D milk as well as all fresh milk; butter as well as all fats; and so forth). For each of these, in turn, there is a price series for the total sample and for each of the three income groups into which the panel is divided. At the end of the year there is a listing of each family's purchases of each product and sub-group of products giving the prices paid each week.

Accompanying the price series for the total sample and the three income groups is quantity and expenditure data expressed on a per capita basis. The percentage of families who bought each product each week is calculated. There are figures expressing the proportion of quantity and expenditure that each product, i.e. pork chops, was of the sub-group, i.e. pork, for each week.

Fruit and vegetable tabulations for 1951 and 1952 were limited to expenditure data only. Quantity and price data could be brought up to date, however. In 1953, they are being tabulated, but with slight modifications from the dairy, meats, and other groups. Grain products, sugars, nuts, beverages, and cooking aids are not being tabulated in detail, but probably will be, starting in 1954.

Theoretically, many types of analyses could be made from these series of data. Price elasticities could be derived for many individual products or subgroups of products. Elasticities could be derived for different products for different income groups; by resorting and retabulating, the control could be for other socio-economic characteristics such as age, education, size of family, special diets, and so forth. If, for example, butter consumption dropped ten percent one could try to determine what socio-economic group was responsible, or even go to the individual families who accounted for the decline to see how this response affected other purchases or total food bill. One might try to determine how certain price relationships in time period 1 affected consumption in time periods 1, 2, 3, and so forth, a dynamic approach.

The interpretation and analysis of the data in measuring price elasticity present some problems. For example, what does a weighted average price mean? Included in it are all the specials and discounts, all grades of the product, in many cases different types and sizes of packages, and in many cases different levels of service. On the face of it one could be very critical of this weighted average price. Yet in some respects it portrays the real world. Also, the old problem of shifts in demand is present, but in new ways—intraseasonal[4] and interseasonal shifts, demand for storage in the home, short-time effects of advertising and promotion, and weather changes. Using yearly data for analysis these demand shifts or shifters are usually disregarded, but in short-time analysis they may be quite im-

[4] In one of the few studies which have attempted to measure intraseasonal shifts in demand, it is stated that: "Lack of data has been one of the major reasons for this deficiency (of empirical descriptions of weekly price variations), and as yet there is little theoretical basis by which research relative to short-term price changes can be guided. Thus, one of the major considerations on which short-run control should rest remains unexplored." G. L. Mehren and H. E. Erdman, "An Approach to the Determination of Intraseasonal Shifting of Demand", *This Journal*, May, 1946, XXVIII: 587-588.

portant. Perhaps supplemental data on some of these variables will be necessary before reliable price elasticities can be derived. There is one problem in demand analysis when national aggregative data are used that probably will be disregarded in analyzing panel data. That is, supply and demand curves may not need to be derived simultaneously since these 250 families, representing a fairly small city, are essentially an insignificant part of the national market for most foods and can be expected primarily to respond to prices instead of derive prices. This does not preclude the use of systems of equations in the analyses, however.

Since tabular data have been available for analysis only a few months, anything I can report on results must be considered strictly preliminary. Harold Riley is attempting to derive price elasticities for beef, pork, poultry, fish, and other meats (mostly cold cuts). He is using single equation least squares methods with four to ten variables. The basic equation for beef, for example, is: Quantity of beef is a function of the price of beef, price of pork, price of poultry, price of fish, price of cold cuts, and an income variable. The modifications of the basic equation involve different methods of handling holiday weeks (Easter, Thanksgiving and Christmas) and removal of non-significant variables in the equation.

Preliminary results, using weekly data, show fairly high degrees of price elasticity for both beef and pork. The elasticities for each fall in the range of -1.3 to -1.5 depending upon the equation used, with the regression coefficients significant at the one per cent level for the mid-1952 to mid-1953 period. The multiple correlation coefficient of the beef equation is .89 and that for pork is .82. With mean values of 3.01 pounds of beef and 2.17 pounds of pork the standard errors of the beef and pork equations are .28 and .31 pounds respectively, or 10 to 15 percent of the mean. The residuals for both the beef and pork equations indicate seasonal variations, illustrating the likelihood of seasonal shifts in demand. One of the problems of analysis is lack of data from enough years to compute the normal seasonals.

With few exceptions the cross elasticity and income elasticity coefficients in the equations are not turning out significant.

The price elasticity for fish and sea food at -1.9 appears to be high compared to any of the so-called meat groups. A seasonal shift in demand associated with the Lenten period, along with seasonal changes in average quality of the commodity labeled "fish and sea food," may have affected the elasticity coefficient. The price elasticity for poultry is -1.4. On the other hand, the elasticity for cold cuts is low at $-.2$ and the coefficient is non-significant at the five per cent level. For this product cross elasticities seem to become important, with prices of pork and poultry being important determinants of variations in quantities purchased.

Mr. Riley has initiated work in the analysis of price elasticity of indi-

vidual cuts of meat for the period mid-1952 to mid-1953. There is evidence, for example, that the price elasticity for beef steak approaches the figure −2.5, while that for roasts is about −1.3. Hamburger, on the other hand, is quite inelastic, at about −.2. In fact, it is quite possible that due to income effects hamburger may have a positive elasticity when beef prices are rising. May I repeat that these findings are preliminary, and will be more fully developed in future publications.

Future work in price elasticities will include meats as well as other food products. A companion project under the leadership of Dr. Kramer of our department will intensify work in the analysis of the demand for meats. His work will pursue the analysis at the level of individual cuts of meat as well as the subgroups listed above, and will include elasticities, cross elasticities, and income elasticities.

Analyses have been started on fats and oils and eggs. The butter analysis is off to a peculiar start; despite a twenty-cent range in prices, the coefficient of simple correlation between butter prices and butter purchases equals zero. An interesting and perhaps highly significant observation can be reported, however. During 1951, about fifty percent of the families were buying butter quite regularly each week. In early 1952, butter prices spurted to nearly ninety cents a pound and held at that level a few weeks. The percentage buying butter immediately dropped to forty-five percent and has held at that level since, despite a price drop to 70 cents. Perhaps this is an example of the so-called "reaction threshold," but there has not been an opportunity to witness a reaction in the opposite direction.[5] A similar interesting observation may be reported for eggs. As the prices of eggs began to rise seasonally in the summers of 1951 and 1952, purchases dropped consistently for several weeks, but purchases began to increase again several weeks before prices started going down seasonally. Intraseasonal shifts in demand, if properly measured, might account for this phenomena.

Cross Elasticity

It was originally hoped that studies in cross elasticities would receive the major emphasis in our work. The problems of interpreting the data and handling the data are quite similar to those described above for price elasticity. On the other hand, the background of experience is more limited and the statistical methods probably are not as well developed or accepted.[6] Conceptually, in cross elasticity, we think of no more than two

[5] For examples using this psychological concept see Warren J. Bilkey, "The Basic Relationships in Consumer Expenditure Behavior," Harvard Studies in Marketing Farm Products, No. 4-H, 1951, pp. 36-41.

[6] See especially Adolph Kozlik, "An Investigation of Complementary Relations Between Fresh Fruits: A Reply," *This Journal*, August, 1941, pp. 654-655, and Irving Morrissett, "Some Recent Uses of Elasticity of Substitution—A Survey," *Econometrica*, January, 1953, pp. 41-62.

products at a time, with all others constant. More likely others are not constant. Instead it is likely that there are bundles of products, each one in the bundle being a substitute or complement for others to varying degrees. How does one handle ten variables, for example, each one dependent upon the others, in determining the elasticity of substitution of one for the other? Some other questions might be raised. Are sets of complements substitutes for other sets of complements? If so, must price combinations be considered?

Another very serious question is—how does one find out what the substitutes and complements of a product really are? Do we know enough about consumer buying habits and meal planning to arrive at the proper list by reason alone? We have done a little spade work on the application of the method of multiple factor analysis to the analysis of economic data. This method has been used primarily in research in psychology. Dr. Harriet Siegel, in her Ph.D. dissertation, considered seventy-six variables to determine what factors had been operative on dairy products in the nation over the 1929 to 1948 period, and then set up predicting equations for the disappearance of dairy products based upon the factor analysis.[1] Her method produced variables similar to what might arise in constructing a model based on theory. It seems reasonable to try this method at least in trying to get a rough approximation to products that are substitutes or complements.

Income Elasticity

Another area of study in which we have thought that panel data would be particularly useful is income elasticity. Very little analysis of income data has been made with the panel data thus far. Each week each family reports its income actually received that week. The income figure represents what might be called personal income less federal income taxes, except that the personal income includes no imputed rent to owner-occupiers. About ten percent of the panel members are unable to provide very useful income data, a few are unable to give weekly data but can supply annual data, but for the great bulk of the panel members the weekly income figures seem to be fairly reliable. About income tax time each year we check their stated annual incomes with our weekly totals and try to straighten out any discrepancies in our weekly figures for the past year.

The most challenging aspect of the work in this area perhaps will be a more or less dynamic approach. In other words, what is the effect of an increase in income in time period 1 upon purchases in time periods 1,

[1] Harriet S. Siegel, "The Application of Multiple Factor Analysis to the Aggregate Demand for Dairy Products," unpublished Ph.D. thesis, Michigan State College, 1951.

2, 3, and so forth? Here again we will be treading on fairly new ground as far as research methods and interpretation are concerned. Another promising area is income elasticities among different socio-economic groups, particularly income groups, using time series analysis. From this, one might determine probable results of proposals for redistribution of income.

Cross-sectional analysis can be applied to a wide variety of products, in reality from soup to nuts, using total purchases for the year for individual families. Although panel data probably have some reporting weaknesses, cross-sectional analysis of annual family panel data should provide some information which is supplemental to the many one-time surveys that have been made, particularly for those products which are bought irregularly and infrequently, seasonally, or are under-reported or telescoped during interviews. An attempt has been made to determine an income-expenditure elasticity for meals away from home and for food bought for use at home. Annual expenditures data of 125 families who sent in fifty or more diaries in 1952 were used. Using per capita income and per capita expenditures for each family, the income elasticity for meals away from home was +1.1. On the other hand the income-expenditure elasticity for food purchased for preparation at home was +.13.

Last, but not least, some effort should be made to explain the divergence of results so often obtained when income elasticities are derived by the two methods, cross-sectional and time series analysis, since we have both types of data on the same families.[8]

Research Other Than Demand Analysis

Panel data provide a mass of information which is not directly related to studies of elasticities, but which might be termed supplemental to them. This information includes consumer purchase patterns, buying habits, allocation of the food dollar, and others which have many practical applications. Some examples will be mentioned.

Researchers in egg marketing have been quite concerned about quality deterioration of eggs between the farm and retail store. Panel data show that about seventy percent of the families buy eggs each week; or on the average, purchases are made about every ten days. This means that the average egg is in the home five days before eaten, or there is a potential of nearly as much quality deterioration in the home as in the marketing channels.

The dairy industry should be interested in knowing that although butter

[8] For an excellent résumé of studies on income elasticities of food see T. W. Schultz, *Economic Organization of Agriculture,* (New York: McGraw-Hill Book Co., Inc., 1953), pp. 44-82.

and margarine consumption are about equal (both in the nation and in the panel) most of the people try butter at least some time during the year. Over ninety percent of the panel families bought butter at least once in 1952. On the other hand, many high butter consumers give margarine a try, too. Over ninety percent of all families bought some margarine in 1952. Of interest also is the fact that twenty percent of the families bought fifty percent of the butter. Likewise, twenty percent bought fifty percent of the margarine.

These purchase patterns are not as widely divergent for meats, apparently. The high twenty precent of the families bought thirty-five percent of the pork. This same twenty percent, however, bought twenty-four percent of the beef, or about the same amount per family as the average. Likewise, twenty percent of the families bought thirty-five percent of the beef, and this same twenty percent bought twenty-four percent of the pork. For both beef and pork, there were many families in which per capita purchases were at least fifty percent above the average, and many other families in which per capita purchases were less than half the average. With further research one could try to characterize these groups which have widely divergent consumption patterns.

Another area in which data have been needed are seasonal purchase patterns for most products. Our study shows, for example, that over fifty percent of the consumers' fresh-apple dollars are spent in three months, about fifty percent of the tangerine dollars are spent in one month, and that potato expenditures in some months are only two-thirds those of other months. The data show that in one month twenty-three percent of all fruit purchases were strawberries, but this figure dropped to one or two percent in other months. On the other hand, oranges and orange juice ranged from thirteen percent to twenty-three percent of the fruit expenditure. In the lowest month an average of thirty-six percent of the families bought oranges or orange juice each week.

Using annual data it is possible to secure fairly reliable information on the allocation of the food dollar all the way from the major food groups down to the 500th item on the list. This can be done for the sample or any segment of it. Panel data show, for example, that families with high, middle, or low incomes spend about the same proportions of their home food bills for the food group which includes meats, poultry, eggs, fish and sea food, but that the high income families spent a slightly higher share on beverages and dairy products and a slightly lower share on fats and oil, sugars, and grain products than the low income families.

These are a few simple illustrations of the types of data which might be useful in practical problems of merchandizing—allocation of display space

in stores as the seasons change, proper package sizes, directed advertising and promotion, crop movements and storage, and so forth.

Another broad area of research to which panel data might be made useful is the field of nutrition. It has been stated that this is a type of information which some nutritionists have desired for a long time.[9]

Outlook and Conclusion

Consideration is being given to improving the usefulness of the M. S. C. Consumer Panel by extending it to one or more additional Michigan cities. Two chief advantages of such an extension would be that a wider geographic area would be represented and there would be an opportunity for a certain amount of controlled experimentation. One such experiment might involve measuring the short-time responses to advertising and promotion campaigns. Another might involve interjecting certain price relationships into a local economy or individual homes, such price relationships being those which are outside the realm of recent experience, but which might be possible under subsidy programs.

In conclusion, it is our opinion that the consumer purchase panel method has considerable potential as a method of securing data for demand analysis and related studies. By providing a continuous flow of data over time such that certain variables are simultaneously measured or held constant, a new type of information is made available. It is very prolific in its yield of data. On the other hand it is relatively costly, and as such the problem of sample size emerges. The continuous nature of the panel involves unusual problems in sampling, as well as the conditioning effect of record-keeping upon the panel members themselves. Three years of the panel operation have not dampened our earlier enthusiasm, however.

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[9] Margaret A. Ohlson, Head of Department of Foods and Nutrition, Michigan State College.

MORE ECONOMICAL COTTONSEED OIL MILLS AND RETURNS TO GROWERS*

JOHN M. BREWSTER
Agricultural Marketing Service

UNDER the Agricultural Marketing Act, the Department of Agriculture's National Cottonseed Advisory Committee recommended that a study be undertaken to determine what types and sizes of cottonseed oil mills would constitute the most economical industry. In addition, they desired that measurement be made of the effect of industry-wide shifts in types of mills on returns to growers of cottonseed. This paper is an account of the major problems encountered in both these assignments.[1]

In handling the first assignment, it was initially assumed that the size of mill (whatever the type) is determined by conditions of efficiency under approximately "perfect competition." It was later found, however, that mills are actually far smaller than can be explained by this assumption, owing to special conditions of competition ("reasonable competition") for seed. These conditions did not permit specification of the most economical *size* mill in any locality. What, then, could be done with the first assignment under this circumstance?

These matters are treated in the first four sections of the paper; the fifth deals with the effect of industry-wide change in types of mills on returns to growers.

Types of Processes

Three preliminaries afford a useful setting. First, four types of mills were involved: the hydraulic, screw press, direct-solvent and prepress-solvent.[2] The oldest and most prevalent process, by far, is the hydraulic. Screw press mills were introduced after World War I; the first direct-

* The author is indebted to C. B. Gilliland, and other members of the Special Crops Section, Market Organization and Costs Branch, Marketing Research Division, AMS, for helpful criticism in the development of this paper and the technical report on which it is based. The assistance of Donald Jackson deserves particular acknowledgement.

[1] See John M. Brewster, *Comparative Efficiencies of Different Types of Cottonseed Oil Mills and Their Effects on Oil Supplies, Prices and Returns to Growers*, U. S. Department of Agriculture, Agricultural Marketing Service, Washington, D.C., Bulletin No. 54, Marketing Research Report, 1954. A summary of this detailed report by the same author is *Cottonseed Oil Mills: Their Comparative Efficiencies and Effects on Prices and Producers' Returns*, U. S. Department of Agriculture, Production and Marketing Administration, Washington, D.C., Agriculture Information Bulletin No. 103, 1953.

[2] Differences between these processes reside in techniques for separating cottonseed meats into oil and meal. In hydraulic mills, the meats are subjected in batches to mechanical pressure, while in screw press mills they are fed continuously. In direct-solvent mills, the oil is washed from the meats with a solvent—usually hexane. In the prepress-solvent process, the meats are run through screw presses for partial oil recovery and then passed on to the solvent "extractor."

solvents at the close of World War II, and the prepress-solvents about 1949. In 1948, when the study of comparative plant efficiencies was begun, there were only four direct-solvents. However, the soybean industry had widely adopted the solvent process and the question arose if the cottonseed industry should not do the same.

Second, as the types and sizes of mills to be studied existed nowhere under the same conditions, their comparative efficiencies could be measured only through designing model mills, using engineering data properly checked against operating experience. This left to local judgment whether it is more economical in a given case to shift to a new mill or continue exploiting the useful life of the old one, either with or without remodeling.

Finally, the comparative economies of mills had to be expressed in terms of net revenue per ton of seed instead of cost per unit of output. For mills have no identical unit of output since they produce joint products –oil, meal, linters, and hulls–in varying proportions, as illustrated in Table 1.

TABLE 1. POUNDS OF JOINT PRODUCTS PER TON OF COTTONSEED BY TYPE OF MILL[a]

Type of mill	Oil	Meal	Linters	Hulls	Moisture loss	Total
Hydraulic	316.8	829.6	178.0	569.6	106.0	2000.0
Screw press	325.0	829.6	178.0	561.4	106.0	2000.0
Direct solvent	352.0	829.6	178.0	534.4	106.0	2000.0
Prepress solvent	359.0	829.6	178.0	527.4	106.0	2000.0

[a] These proportions will vary among localities in line with corresponding variations in the oil and ammonia content of seed, the latter governing meal outturns per ton of seed. The extra oil, which is extracted from the meal by the higher oil yielding processes, is replaced in the meal by an equivalent weight of hulls so that meal yields from seed of the same quality remain constant for all mills while hull yields vary by type of mill.

But they do process an identical unit of seed into different combinations of products. Therefore, both the cost and revenue of these products could be expressed as cost and revenue per ton of seed (Figs. 1 and 2); hence, relative efficiencies at any level of operation could be determined by comparing net revenues per ton of seed (Fig. 3). When compared in this manner, mills least efficient in terms of cost per ton of seed processed were usually the most efficient in terms of net revenue as they increased their revenue more than their costs (Figs. 1 and 3).[3]

[3] This method required the extra work of calculating revenues for each product, which was not troublesome for oil and linters because prices for these products are quite uniform throughout the industry. But it was burdensome in case of meal and hulls, as varying amounts of these products are sold in local markets at prices which vary widely among localities; also, there is considerable variation in their wholesale market prices. Calculating meal revenue was further complicated by the fact that as many as five different forms of meal may be produced and each form sold both locally and wholesale.

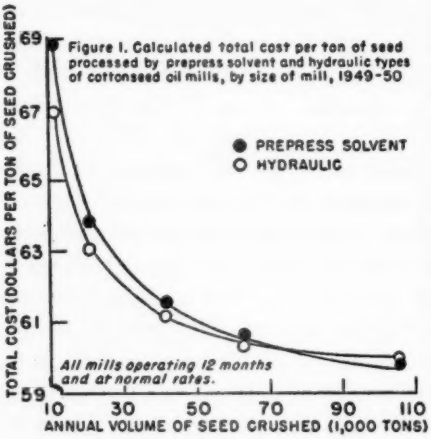


Figure 1. Calculated total cost per ton of seed processed by prepress solvent and hydraulic types of cottonseed oil mills, by size of mill, 1949-50
TOTAL COST (DOLLARS PER TON OF SEED CRUSHED)
69
67
65
63
61
59
PREPRESS SOLVENT
HYDRAULIC
All mills operating 12 months and at normal rates.
10 30 50 70 90 110
ANNUAL VOLUME OF SEED CRUSHED (1,000 TONS)

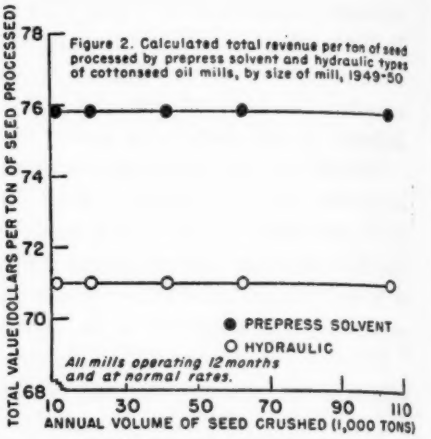


Figure 2. Calculated total revenue per ton of seed processed by prepress solvent and hydraulic types of cottonseed oil mills, by size of mill, 1949-50
TOTAL VALUE (DOLLARS PER TON OF SEED PROCESSED)
78
76
74
72
70
68
PREPRESS SOLVENT
HYDRAULIC
All mills operating 12 months and at normal rates.
10 30 50 70 90 110
ANNUAL VOLUME OF SEED CRUSHED (1,000 TONS)

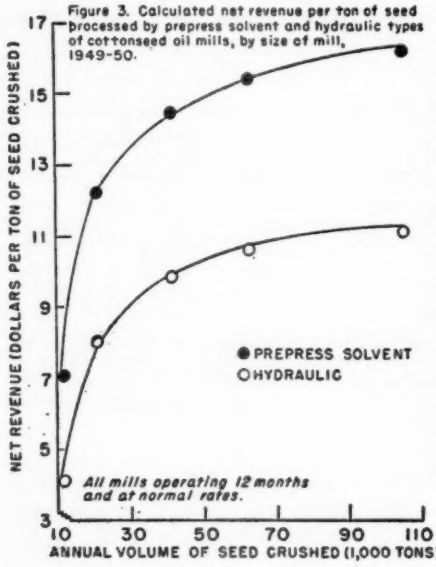
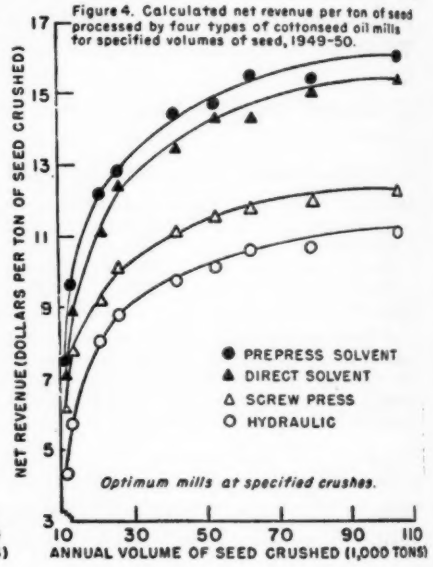


Figure 3. Calculated net revenue per ton of seed processed by prepress solvent and hydraulic types of cottonseed oil mills, by size of mill, 1949-50.
NET REVENUE (DOLLARS PER TON OF SEED CRUSHED)
17
15
13
11
9
7
5
3
PREPRESS SOLVENT
HYDRAULIC
All mills operating 12 months and at normal rates.
10 30 50 70 90 110
ANNUAL VOLUME OF SEED CRUSHED (1,000 TONS)



Scale of Plant

As previously stated, the study initially assumed that size of mill throughout the industry is limited by conditions of efficiency under approximately perfect competition. If this were true, the question of which sizes and types of mills would constitute the most economical industry could be resolved as follows: (1) In a given mill area (locality) and starting with the smallest mill of a given type, say hydraulic, (a) find its optimum crush through varying its daily crushing rate and length of season until that volume of seed was found which would yield the most net revenue under given cost-price relationships. (b) By repeating this procedure for larger

and larger hydraulic mill, find that crush and size of mill which yields the most total net revenue. (2) By repeating (1a) and (1b), find the optimum mill for each of the other three processes in the given mill area. (The volumes of seed representing these optimum mills might be quite different, and probably would be.) By repeating all the above steps for representative locations, find which types and sizes of mills would constitute the most economical industry in terms of *total net revenue per mill.*[4] (Practical interest of the industry is in the greatest net revenue *per ton* of seed rather than in total net per plant or firm.)

As soon as sufficient data became available, this procedure was tested. In this test, the volumes of seed processed annually ranged from approximately 2,000 to 150,000 tons, representing both the smallest and largest mills in the industry.[5]

The test was expected to show that the optimum mill varied among localities approximately as seed densities and size of local meal and hull markets. This expectation rested on three considerations. First, there would be some decline in the total value of products per ton of seed as the size of mill increased because the larger the crush the greater is the proportion of meal and hulls which usually must be sold wholesale at prices lower than those received for local sales. Second, the larger the mill in any locality, the farther it must go for seed; hence, average charges for hauling seed will rise throughout the increasing scale of operations. Third, by common assumption, cost per unit will fall for a time as size of plant increases and finally rise at an increasing rate, whatever the locality.

The cost-revenue relationship with size of mill was then worked out in the densest seed producing locality of the cotton belt. It was found that economies, arising from increasing the scale of operation (whatever the type of mill), always more than offset (1) any decline in revenues and (2) increasing charges for hauling seed as well as (3) any increase in internal costs, which were always minor. The same test was then repeated in the sparcest seed locality in the cotton belt where seed haul costs would rise most sharply with expanding operations. But the result was the same as in the first test.[6]

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[4] The author is indebted to R. G. Bressler for assistance in formulating these steps and the techniques for their execution. Also, particularly instructive were his two papers: "Economies of Scale in the Operation of Country Milk Plants" (The New England Research Council on Marketing and Food Supply, the New England Experiment Stations, and the U. S. Department of Agriculture, Boston, 1942, 92 pp.); "Efficiency in the Social Science Research Council Project in Agricultural Economics." University of Chicago. Summer 1950. 67 pp.

[5] In fact, the scale included model mills which were somewhat larger (400 tons per day) than any mill in existence when the study was begun. Larger models were not used as they might lead to unrealistic conclusions because there was no experience by which they could be checked.

[6] Calculations were carried to a point where mills were considered as hauling

This meant that, under the assumed conditions of approximately perfect competition, the mill required to maximize total net revenue, even in the least dense seed producing area in the entire cotton belt, would have to be larger than the biggest mills anywhere in the industry, which always happen to be in the highest producing areas. The 1946-49 average crush was only 15,410 tons. Up through 1949, no mill crushed over 100,000 tons.

Limitations on Expanding Size

The assumption of approximately perfect competition for seed was therefore abandoned; it could not explain why mills are so small. But "reasonable competition" could. Cottonseed is a by-product of cotton and does not vary in quantity with change in seed prices. Hence, a mill can increase its usual seed supply only by diverting seed from its competitors. But that sky-rockets the competitors' processing cost, forcing them to offer whatever price is necessary to protect their customary supplies. Mutual survival thus requires that competitive price offers be limited to a point which does not wreck the overall distribution of customary shares in a fixed and limited total seed supply.[7] As a consequence, the mill which will maximize net revenue must be smaller than it would be under perfect competition, where the cost of diverting seed from competitors does not arise.[8]

In seeking to expand his customary seed purchases as means of achieving the economies of a larger mill, any operator is thereby usually faced with a new cost of diverting seed from his competitors. But there is no way of specifying how this cost may increase as he enlarges his plant.[9] More-

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seed over 600 miles. In checking these calculations with mill operators, it was found that some large mills actually haul seed even farther than this, as a regular matter, if they can get it at prevailing prices. (These "check mills" were substantially smaller than the largest models used in the study.)

[7] Much complicated theory is required to explain how such "customary shares" become relatively stable over a period of time, but this need not be gone into here. *See* W. H. Nichols, "Market-Sharing in the Packing Industry." Feb. 1940 issue of *This Journal*, pp. 234-240. Also by the same author, *Imperfect Competition within Agricultural Industries*, The Iowa State College Press 1941, pp. 120-130.

[8] "Spatial monopoly" does not limit the size of mills under the existing economy. The cottonseed industry has a spatial monopoly characteristic which is reflected in the fact that the costs of buying and hauling in seed from gins increase with size of mill in most any locality. Nevertheless, reasonable competition, arising from the fixed and limited nature of the total seed supply, actually limits the size of mills to a point far below that which would be established by the spatial monopoly aspect of the industry under certain assumed conditions, such as a government licensing system that might withhold seed from all except the minimum number of mills required to handle the total seed supply most economically. Under this circumstance, spatial monopoly would indeed determine the sizes, locations and total number of mills in the industry.

[9] To be sure, there is much local insight on this matter, but it cannot be stated quantitatively, though each operator usually has a clear enough concept of his margin to avoid a "price war."

over, only local judgment can have any awareness of the volumes of seed which are available at uniform prices.

Most Efficient Size of Mill

Given these indeterminancies, the most economical mill can be calculated only by using uniform prices for specified volumes of seed, leaving to local judgment the question of how much seed is actually available. Before this calculation could be made, two questions had to be resolved. First, what volumes of seed should be specified? Second, how may the optimum mill for each volume be determined (a) in a particular locality and (b) for any unspecified locality?

In handling the first question, three factors had to be considered: The rate of operation, the length of operating season, and the types of mills.

The amount of seed, which any mill can crush annually, varies tremendously, depending on its operating rate and length of season. If seed is available, the most economical season was found to be a 12-month period, and the most economical rate was far in excess of any "normal" rate. Within the limits of the rates found in the industry, the greater volume of seed processed per unit of time, the greater was the total net revenue per mill, even though lower rates yielded more oil and hence net revenue per ton of seed. On the average, however, mills cannot use the fastest rate, as the seed supply varies from year to year with cotton acreage and yield per acre.

Therefore, to the extent possible, it was desired to compare all four processes at crushes representing a 12-month season and *normal* rates, realizing that rate or season might need to be altered in line with annual variations in seed supply.

This could always be done with respect to rate but not season, as the daily capacity of all four types of mills was seldom identical. Only five sizes of direct-solvent mills were usually available from manufacturers, and the same was true for prepress-solvents. All these units had to be used to have enough observations for these 2 processes. Operating at their normal rates for a full season, these 10 mills represented 9 volumes of seed, as shown in Table 2, because only the two largest mills had the same daily capacity. These volumes also corresponded to 5 screw-press and 8 hydraulic mills, operating a 12-month season at their normal rates.

But comparisons for each crush were not restricted to these 23 mills, for two reasons. Only by using a shorter operating season for some commercially available mills could the efficiencies of all 4 processes be shown for each specified crush. Again, though 12 months is the most profitable season for a given mill, the larger of 2 mills, by working a shorter season, may crush at less cost the same volume of seed handled by the smaller mill in a 12-month season. So, as illustrated in Table 3, the above total of 23

TABLE 2. ANNUAL CRUSHING CAPACITIES OF PREPRESS- AND DIRECT-SOLVENT COTTONSEED CRUSHING PLANTS OPERATING AT THEIR NORMAL RATES FOR A 12-MONTH SEASON

Plant	Volume of seed processed per 24 hours	Annual capacity
	Tons	
Prepress solvent:		
Plant 1	40	10,560
Plant 2	80	21,120
Plant 3	160	42,240
Plant 4	240	63,360
Plant 5	400	105,600
Direct solvent:		
Plant 1	50	13,200
Plant 2	100	26,400
Plant 3	200	52,800
Plant 4	300	79,200
Plant 5	400	105,600

mills was expanded, by varying the length of season, to provide enough other mills of the right specifications for determining the optimum mill of each type for each crush. Thus expanded, the scale of operations included 67 mills.

The revenue-cost relationship of these 67 mills was then worked out so as to determine what mill of each type was most economical for each of the 9 crushes in six selected mill areas. Figure 4 illustrates the net revenues for the optimum mills of each process for each of the specified crushes in area I (Southeastern North Carolina).[10] The height of the curves in this figure varied somewhat among areas, but their slopes were similar.

The most efficient mill for a given crush in one location was not neces-

TABLE 3. COTTONSEED OIL MILLS, BY TYPE OF PROCESS, AND OPTIMUM MILL OF EACH TYPE RANKED IN THE ORDER OF CALCULATED PROFITABILITY, FOR 10,600 TONS OF SEED CRUSHED ANNUALLY IN SIX SELECTED MILL AREAS, 1949–50[a]

Type of process	Plant	Crushing capacity per 24 hrs.	Length of operating season	Order of profitability (1 is most protable)					
			Months	Area I	Area II	Area III	Area IV	Area V	Area VI
		Tons	*Number*						
Prepress solvent:	Plant 1	40	12.0						
	Plant 2	80	6.0	1	1	1	1	1	1
Direct solvent:	Plant 1	50	9.6		2	2	2	2	2
	Plant 2	100	4.8	2					
Screw press:	2 press	50	9.6						
	3 press	75	6.4	3	3	3	3	3	3
Hydraulic:	4 press	40	12.0						
	6 press	60	8.0	4	4	4	4	4	4
	8 press	80	6.0						

[a] Areas selected to include the extremes in the industry of all important cost items, seed qualities, cottonseed production, and meal and hull market characteristics.

[10] Figures 1, 2, and 3 are also for area I.

sarily the most efficient in others because of local differences in cost and marketing factors. A final question thus arose on how the most economical mills could be determined throughout the industry for each of the specified crushes. This was resolved through two steps. First, a very few localities were found which included the extremes of all important cost items, seed qualities, availability of seed, and market patterns for meal and hulls in the industry. Six proved enough.[11] As shown in Table 4, analysis of cost and returns for mills, handling each crush most economically, in these selected areas gave the range of relative profitabilities within which the same mills would usually fall in any locality.

Second, the cost and marketing factors in these six localities, were then combined into an extreme case in a way that showed the least possible gains in profit which might arise in any area through shifting from the hydraulic to any other type of mill for each of the specified volumes of seed (Table 4). For example, with respect to costs, mill area I had the lowest wage rate in the cottonseed industry, whereas mill area VI had the highest. The labor requirements of the hydraulic process are more than those of the prepress-solvent process; hence, the lower the wage rate, the better is the competitive position of the hydraulic process for any given crush. Wage rates of area I were therefore used in the extreme case in order to show the least possible increase in profit that could result in shifting from the hydraulic to the prepress-solvent process at any specified crush.

Effects of Changes on Growers' Returns

Attention is now directed to the second problem of the study: How would industry-wide shifts to more efficient mills affect returns to growers of cottonseed? This required a prior determination of how such shifts would affect the price of cottonseed oil by changing the total oil outturn from a given seed crop.[12] These changes are shown in Table 5, using 1949-50 supply-demand relationships and oil yields for each type of milling process at their normal operating rates on 1949-50 average quality of seed.

At this point, the above query is split into two parts: How much additional revenue could be made available to growers, in the form of higher seed prices, by industry-wide shifts to more efficient mills? What season,

[11] They were identified as: mill area I—Southeastern North Carolina; mill area II—North Delta, Arkansas; mill area III—South Delta, Louisiana; mill area IV—Eastern Oklahoma; mill area V—North Blacklands, Texas; and mill area VI—Central California. That these areas included the extremes of the items just cited was inferred from a description of some 50 widely scattered mill areas. Because of limited space, this description is omitted here; it is presented in Chapter I of the second citation in footnote 1.

[12] For reasons stated in the first section, industry-wide shifts to higher oil yielding processes would lower the supply of hulls somewhat but not enough to appreciably affect their prices. Meal and linter supplies would remain the same.

TABLE 4. CALCULATED DIFFERENCES IN NET REVENUE PER TON OF SEED CRUSHED ARISING FROM CHANGES IN TYPES OF COTTONSEED-OIL MILLS AT SPECIFIED ANNUAL CRUSHES, 1949–50

Minimum and maximum in six selected mill areas

Size of crush (tons)	Difference in net revenue	Dollar gains in net revenue in shifting from—[a]				
		Hydraulic to—			Screw press to—	
		Screw press	Direct solvent	Prepress solvent	Direct solvent	Prepress solvent
10,600.....	Minimum	1.13	1.91	2.30	0.24	0.63
	Maximum	2.42	2.71	3.30	1.28	1.89
13,200.....	Minimum	.99	2.33	2.93	.57	1.17
	Maximum	2.61	3.23	3.87	1.70	2.37
21,100.....	Minimum	1.05	2.28	3.12	1.05	2.09
	Maximum	1.98	3.37	4.25	2.25	2.81
26,400.....	Minimum	1.08	2.82	3.09	1.25	1.52
	Maximum	2.28	4.09	4.31	2.50	3.23
42,200.....	Minimum	.89	2.66	3.75	1.37	2.46
	Maximum	1.81	3.93	5.00	2.81	3.59
52,800.....	Minimum	1.08	3.25	3.49	1.59	1.83
	Maximum	2.37	4.81	4.68	2.85	3.27
63,400.....	Minimum	.86	2.64	3.84	1.43	2.63
	Maximum	1.72	4.02	4.98	3.16	3.71
79,200.....	Minimum	1.15	3.65	3.87	2.03	2.25
	Maximum	2.28	4.92	4.86	3.15	3.58
105,600.....	Minimum	.98	3.68	4.36	2.29	2.97
	Maximum	1.98	4.72	5.34	3.15	3.81
Minimum in any area						
10,600.....		0.98	1.54	2.05	−0.16	0.71
13,200.....		.90	1.84	2.46	.28	1.01
21,100.....		.70	1.96	2.83	.78	1.64
26,400.....		.96	2.52	2.71	1.11	1.46
42,200.....		.79	2.52	3.35	1.17	2.26
52,800.....		1.04	3.05	3.24	1.59	1.70
63,400.....		.69	2.49	3.43	1.40	2.53
79,200.....		1.05	3.25	3.41	1.80	1.96
105,600.....		.85	3.18	3.67	1.89	2.65

[a] Comparisons of mills are expressed as a change from lower to higher oil yielding processes. The present industry is predominantly hydraulic, with screw press mills ranking next in importance.

if any, is there to suppose that these gains would actually be passed on to growers?

The first question required a comparison between the cost and returns of the marginal mill of the current (predominantly) hydraulic industry with those of the marginal mill of each industry which may be assumed as

TABLE 5. CALCULATED EFFECT OF INDUSTRY-WIDE CHANGES IN TYPES OF COTTONSEED OIL MILLS ON OIL RECOVERY PER TON OF SEED, AND ON COTTONSEED OIL SUPPLY AND PRICE, 1949–50[a]

Type of mill	Oil recovery per ton of seed		Cottonseed oil supply from given seed		Supply of fats and oils, excluding butter and lard, used in food products		Price of cottonseed oil per pound[e]	Decrease in price of cottonseed
	Total[b]	Increase	Total[c]	Increase	Per capita[d]	Increase		
	Pounds	*Percent*	*Million pounds*	*Percent*	*Pounds*	*Percent*	*Cents*	*Percent*
Hydraulic	323.0	0.0	2,303	0.0	30.42	0.0	11.67	0.0
Screw press	331.2	2.5	2,351	2.1	30.74	1.1	11.46	1.8
Direct solvent	358.2	10.9	2,510	9.0	31.79	4.5	10.79	7.6
Prepress solvent	365.2	13.1	2,551	10.8	32.06	5.4	10.63	8.9

[a] All mills assumed as operating at their normal rates.
[b] Oil recovery of 323 pounds reported by U. S. Census as the actual yield and assumed to be equivalent to yield of a complete hydraulic industry operating at 10 tons per press per 24 hours.
[c] Calculated on basis of 5,868 tons of cottonseed sold to mills×corresponding oil recovery per ton of seed+408 million pounds of cottonseed oil in stocks at factories and warehouses, January 1, 1950.
[d] Calculated on basis of cottonseed oil supply per person for 151.3 million persons+15.2 pounds of other edible oils, excluding butter and lard, per person.
[e] Based on 1949–50 average price of 11.67 cents per pound assumed as received by hydraulic industry operating at normal rate and adjusted for other rates and processes by use of demand-price relationships for cottonseed oil developed by Bureau of Agricultural Economics.

replacing the current one.[13] In most cases, the smaller the mill, the higher its costs; accordingly, the term "marginal mill" is here used to signify the smallest mill (or mills) whose total cost must be covered to induce the industry to maintain its current level of output. It is not necessarily either the smallest size mill or the highest cost mill in the industry, as there is usually an appreciable number of other mills, either smaller or larger, which contribute to the current output of the industry but whose costs do not have to be fully met to induce that output.[14]

In these terms, conceivable benefits to growers (in the form of higher cottonseed prices) from industry-wide efficiency gains, are a function of change in the size and type of the industry's marginal mill. Measurement of this change required a determination of the size (1) of the marginal mill of the current hydraulic industry and (2) of each alternative industry which may be assumed as replacing the current industry.

[13] It was initially surmised that the effect of industry-wide change in type of mills on the value of seed to cotton growers could be measured through use of a correlation between the price per ton of seed received by farmers and the value at mills of cottonseed products per ton of seed. This surmise rested (1) on the fact that different types of mills yield different total revenues per ton of seed and (2) on the assumption that change in *type* of mill would have no appreciable affect on processing costs. However, as illustrated in Figures 1 and 2, industry-wide change in type of mill involved a change in both returns and costs per ton of seed at any level of operation. For as Professor Chamberlin has shown on theoretical grounds, it was found that the conventional dichotomy between the "law of scale" and the "law of proportionality" is unrealistic and practically unnecessary. (Chamberlin, Edward H., "Proportionality, Divisibility and Economies of Scale." *The Quarterly Journal of Economics*, Vol. LXII, Feb. 1948.)

[14] In 1949-50, the industry processed a total of 5,868,000 tons of cottonseed. This output was assumed for purposes of estimating the effect of industry-wide shifts to more efficient mills on returns to growers.

Ideally speaking, the first determination requires data on enough properly selected mills to permit a calculation of the average relationship between size of mill and total costs and returns, respectively, per ton of seed. The marginal mill (as previously defined) of the current industry would then be identified on a chart by the intersection of the lines representing these relationships. But the kind of sample required by this method was not obtainable.

An alternative was suggested by a study of the six selected mill areas, previously mentioned. Comparisons were made of all important cost rates, seed densities, sizes of local meal and hull markets, and meal and hull prices for mill localities within each region surrounding each of the six selected mill areas. These comparisons showed that the size of the smallest mill which could meet cost varied only slightly within any given region, but appreciably among regions. Thus, the smallest mill that could cover costs in the Southeast would be substantially larger than in either the North or South Delta, primarily because of higher seed costs. On the other hand, it would be appreciably smaller in either the Texas or Oklahoma regions mainly because of higher meal and hull returns; but it would be substantially larger in the Far West primarily because of higher wage rates. For these reasons, it was tentatively assumed that the size of the marginal mill for the current industry as a whole would not differ appreciably from that which could be calculated by use of engineering data and the (1949-50) cost-price relationships in selected mill area I of southern North Carolina. In line with this thought, the 10,600-ton crush of the model 4-press hydraulic mill (running for 12 months) and the model 6-press hydraulic (running for 8 months) was reduced until cost equaled revenue in each case. This point was reached at 6,000 tons for the 4-press mill and at a somewhat larger tonnage for the 6-press mill.

Persons familar with mill operations throughout the cotton belt were then asked how big an operation would be required under average management simply to meet all costs (including depreciation, interest, taxes and interest on a new plant basis) year in and year out. Their replies were surprisingly close to the above calculated figure of 6,000 tons. Any larger figure was definitely regarded as unrealistic. It was therefore assumed that this figure would not differ appreciably from the size of the marginal mill which might be determined by use of a probability sample if this were obtainable.[15]

[15] This figure further checked with the practice which the government has used from time to time in determining the price necessary to maintain the normal flow of product from an industry. The practice is called the "bulk line method of cost estimating" and consists in setting a price which is high enough to cover the costs of plants accounting for only 90 percent, or slightly less, of the industry's normal output. By this method, 6,000 tons of seed represented approximately the minimum size mill, whose total cost would have to be covered to maintain the industry's normal level of output. For the 1930-50 average crush of the industry was 4,439,981 tons.

A figure of 10,600 tons of seed for mills was used to represent the marginal mill (described in Table 6) for each industry assumed to replace the current industry. No new mills have been constructed in recent years with annual capacities of less than 10,600 tons. No experienced operators were found who ventured the opinion that it would be feasible to construct a new mill of any type if less than this amount of seed were available. Their judgment appeared reasonable in light of the relatively long period required for the profits of model mills of each of the 4 processes to amortize their original investment at 10,600 tons as compared with next larger tonnages. In the six selected areas, the average amortization period for the hydraulic process was approximately 14 years at 10,600 tons, 9 years at 13,200 tons, and 5 years at 21,000 tons. These periods compared with 11, 7, and 4 years for the prepress-solvent process, which were similar to those for the direct-solvent and screw-press processes, respectively.

Under these conditions, comparison of the costs and returns of these mills (Table 6) showed the calculated gains (using 1949-50 conditions) which industry-wide shifts to more efficient mills could conceivably make available to growers in the form of higher prices for cottonseed.[16]

But would growers actually receive these gains? There appears to be no reason to assume the contrary. The cottonseed market is not a monopsonist relationship in which only one mill (seed buyer) confronts many sellers (gins). In the Lubbock, Texas market, for example, gins face three mills. The same principle applies to the Memphis and other "big city" markets as well as the so-called country mills, seldom over 25 or 30 miles from each other. Again, cottonseed is the only major item in cottonseed processing for which growers are the only sellers and mills the only buyers. Perfect competition would, therefore, force the return to growers of all

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There was a total of 346 mills for each of the three post war years (1946 through 1948) when the average crush was 4,167,789 tons, which is not greatly different from the 20-year average just mentioned. Approximately one-third of the 346 mills each crushed 6,000 tons or less and their combined crush could not have been less than 10 percent or more than approximately 13 percent of the 1946-49 average total crush of the industry. (These estimates are based on Table 1 in Agriculture Information Bulletin No. 79, by George W. Kromer and Thomas B. Smith, and on total cottonseed crushed as reported by the Census.)

[16] Industry-wide shifts to more economical size hydraulic mills offer the ficticious possibility of greater benefits to growers than similar shifts to solvent mills of the same size. Change from the 6,000-ton marginal mill of the 1949-50 hydraulic industry to a hydraulic industry with a 10,600-ton marginal mill would result in $1.50 greater saving in processing cost per ton of seed than change to a prepress-solvent industry with the same size marginal mill. The latter industry would give a larger oil revenue per ton of seed because of increased oil yield. But because of lower oil prices, resulting from increased oil supplies, this gain in oil revenue would be substantially less than the above $1.50 greater savings in cost. However, for well-known reasons, a shift to a more economical hydraulic industry is precluded by the competitive process.

TABLE 6. CALCULATED BENEFITS POSSIBLE TO GOWERS OF COTTONSEED FROM INDUSTRY-WIDE SHIFTS TO MORE EFFICIENT COTTONSEED OIL MILLS, 1949–50[a]

Type of industry	Marginal mill		Total revenue per ton of seed	Total cost per ton of seed exclusive of purchase price of seed	Money available to gins for seed	Money available to growers for seed		
	24-hour crushing capacity at normal operating rate	Annual crush				Amount (Col. 3–Col.4) and $3 for ginning services	Additional	Percent increase
	1	2	3	4	5	6	7	8
	Tons	*Tons*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Percent*
Current industry (Predominately hydraulic)	40	6,000	73.51[b]	28.26	45.25	42.25		
Alternatives								
Hydraulic	60	10,600	72.83	23.73	49.10	46.10	3.85	9.1
Screw press	75	10,600	73.06	23.21	49.85	46.85	4.60	10.9
Direct solvent	50	10,600	73.42	25.24	48.18	45.18	2.93	6.9
Prepress solvent	80	10,600	73.78	25.23	48.55	45.55	3.30	7.8

[a] Possible benefits to growers from industry-wide efficiency gains are measured by change in size and type of marginal mill of the industry. The marginal mill (or mills) is the smallest mill whose total cost must be covered if the industry as a whole is to maintain its current level of output.

[b] The smaller mill received a somewhat higher average return on meal and hulls because it could sell a larger proportion of these products in the local market which usually pays more than the wholesale market.

industry-wide efficiency gains, except those which go to consumers in the form of lower oil prices arising from an increase in the oil supply by more efficient *types* of mills. While the industry is actually characterized by "customary" competition, mills do bid against each other for the marginal (last) unit of seed. Accordingly, such competition no more permits the withholding of industry-wide efficiency gains from growers than would perfect competition. It simply prevents the same degree of such gains because, as previously shown, it places a much lower ceiling on the most economical sizes of mills than would perfect competition.

Summary

In summary, it may be noted that the intent and spirit of the Research Marketing Act calls for measurement of not only the possible industry-wide efficiency gains in agricultural processing industries but also the extent to which agriculture itself may thereby benefit as growers of raw materials for such industries. In any given case, this can be done only through measuring the change in the size (and type) of the industry's marginal plant, as previously defined. The mathematically ideal determination of the present size of this plant is seldom, if ever, possible in any major industry. However, this does not necessarily mean that nothing can be done. Less ideal procedures afford workable alternatives if there is evidence for assuming that they will yield results reasonably approximating those which might be obtained from ideal methods. Even such alternatives may not always be possible. But those found in the cottonseed industry were encouraging, and the hope is entertained that the same may be true elsewhere.

THE JOURNAL OF FARM ECONOMICS—ITS FIRST 35 YEARS

CARL J. ARNOLD AND RALEIGH BARLOWE*
Michigan State College

WITH the publication of its December 1953 issue, the JOURNAL OF FARM ECONOMICS completed its first 35 years of service. Significantly enough, this issue also marked the end of the 31-year period during which the Bureau of Agricultural Economics existed as a separate agency of the United States Department of Agriculture.

When the first issue of the JOURNAL appeared in 1919, the field of agricultural economics was still in its infancy. Since then it has developed into an established field; departments of agricultural economics have been established in practically all of the land grant institutions; and considerable progress has come in the development and elaboration of the concepts used in this field. The history of this expansion and development is reflected both in the increasing page-length of the JOURNAL and in the varying emphasis given to the different problems considered.

This article reports a study of the content of the first 35 volumes of the JOURNAL. All of the articles, notes, proceedings papers, and discussions were classified by subject matter, time period, source, and author. Some attention was given to the problem of length or quantity. No effort was made to classify the various contributions from the standpoint of quality.

In the subject matter classification process it was sometimes necessary to make arbitrary decisions regarding the classification of some contributions. Most of them, however, fell logically into one or another of the 22 classifications used. Four time periods are used in this analysis.[1] The first two of these cover the ten-year periods 1919-1928 and 1929-1938. The last 15 years were divided into a seven-year and an eight-year period. The first of these covers the 1939-1945 period while the second covers the post-war 1946-1953 period.

General Trends

Throughout its 35 years of publication the JOURNAL has witnessed numerous changes. The overall size of its pages has remained constant. But there have been important changes in its cover, size, amount of print per page, and in the number and timing of its issues. The first 19 issues were bound in a pale green cover of light stock. Beginning with the first issue of volume 6 in 1924, however, the JOURNAL switched to the light blue cover that has since become its trademark.

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* The junior author is a joint employee of the Production Economics Research Branch, Agricultural Research Service, U.S. Department of Agriculture.

[1] The contributions were also classified into seven five-year periods but only the four period breakdown is used in this report.

The first issue in June 1919 was only 40 pages in length. This compares with the new standard length of 192 pages which was first used in the November 1953 issue. Along with this trend in page length has come a change in the total amount of printed content per page. The early volumes measured 25 × 45 picas of print overall including running heads. This was soon reduced to a standard measure of 24 × 42 picas. In 1951, this measure again was changed to allow 27 × 45 picas overall including running heads. This change together with a change in style of type permitted the inclusion of approximately 20 percent more type per page.

Volume 1 includes only three issues—June, September, and October. Beginning in 1920 four issues were published each year—January, April, July, and October. These publication dates were changed in 1935 to February, May, August, and November. Prior to 1937 the proceedings papers given at the annual meetings were interspersed throughout the regular issues. In 1937 the February issue was designated as the proceedings issue. This practice continued, except for 1945,[2] until 1947, when the editor faced the problem of publishing two sets of proceedings papers. The February 1947 issue was used to report the proceedings of the December meetings. But the proceedings of the summer conference, which was held for the first time that year, appeared as a supplement to the November issue. Since that time four regular issues of the JOURNAL have been published and the proceedings issue has been published separately. Between 1947 and 1951 the proceedings issue appeared as Part 2 of the November issue, but since 1952 it has appeared separately as the December issue.

Along with its increasing size and circulation, the JOURNAL has encountered a problem of rising publication costs. The general trend in this regard is suggested by the following comparison of the specimen contract of January 1927 with the specimen contract of May 1951 under which the JOURNAL is now printed. In 1927 the specimen contract called for the publication of 1,000 copies of 136 pages plus cover for a total cost of $443.51. Under the present contract 2500 copies of a standard issue of 128 pages plus cover cost $1,436.08.[3] Neither cost figure includes postage costs and both must be adjusted for additional copies, longer issues, and allowances for composition costs not included in the specimen contracts.

The first few issues of the JOURNAL were priced at $.35 per copy. In 1920 the annual subscription rate was $1.50. This rate was then raised to $2.00, then $3.00, and in 1926 to the $5.00 annual rate that is still in effect.

The following persons have served as editor of the JOURNAL:

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[2] Because of wartime transportation problems, no annual meeting was held in 1944.

[3] It should be pointed out that although the regular issues printed since 1951 have varied from 144 to 192 pages in size, the JOURNAL is printed under a contract which calls for a minimum of 128 pages.

L. A. Moorhouse	1919-1921	H. C. M. Case	1936-1937
O. C. Stine	1922-1924	T. W. Schultz	1938-1941
Edwin G. Nourse	1925-1926	H. B. Price	1942-1944
Howard R. Tolley	1927-1929	Warren C. Waite	1945-1948
H. E. Erdman	1930-1932	W. W. Wilcox	1949-1951
O. B. Jesness	1933-1935	Lawrence W. Witt	1952-1954

Between 1919 and 1937 each editor was assisted by a staff of associate editors, usually located at other institutions. Between 1938 and 1948 the editors were formally assisted by two or three staff members at their own institutions plus an editorial council made up of persons at other institutions. An editorial council of the type was retained after 1949 but the editor is now assisted by an associate editor and a book review editor.

Total Contributions

Table 1 reports the number and page length of the contributions published in the JOURNAL during the 1919-1953 period. Counting book reviews, some 3,774 separate contributions were published. These covered a total of 24,751 pages. Regular articles account for 19.0 percent of the total number of these contributions while notes account for 13.3 precent, proceedings papers 29.6 percent, proceedings discussions 13.6 percent, and book reviews 24.5 percent. From the standpoint of total pages devoted to author contributions, approximately 36.9 percent were used for articles, 8.3 percent for notes, 42.3 percent for proceedings papers, 5.4 percent for discussions, and 7.1 percent for book reviews. During recent years more emphasis has been given to the publication of articles and notes than to the solicited papers presented at the annual meetings.[4] The proportion of the space used for voluntary contributions increased from 37.2 percent in the first period and 39.2 percent in the second, to 62.2 percent in the third, and 51.1 percent in the final period. The high percentage reported during World War II may be credited to reduced participation at annual meetings during the war years. This trend has been further implemented since the war by the decision to publish four full issues each year in addition to the proceedings issue. At the same time that the number of articles and notes increased, the length of the average article increased from 9 pages in the first period to 11.5 pages in the second, 13.3 pages in the third, and 15.0 pages in the final period.

Some of the most interesting changes suggested by Table 1 relate to the emphasis given to notes, proceedings discussions, and book reviews. Only a relatively small number of notes and discussions were published during

[4] It is recognized that from time to time editors have found it either necessary or desirable to solicit articles. These articles cannot be readily identified and thus no attempt has been made to separate them from articles and notes submitted on a voluntary basis.

TABLE 1. NUMBER AND PAGE LENGTH OF CONTRIBUTIONS BY TYPE AND TIME PERIOD, 1919–1953

Section	1919–1928		1929–1938		1939–1945		1946–1953		Totals for 35 years	
	Number of contributions	Page Length	Number of contributions	Page Length	Number of contributions	Page Length	Number of contributions	Page Length	Number of contributions	Page Length
Regular articles	116	1,044.2	167	1,927.7	215	2,859.0	220	3,305.9	718	9,136.8
Notes	8	36.9	211	585.4	100	473.3	181	948.6	500	2,044.2
Proceedings Papers	174	1,691.9	344	3,425.6	175	1,740.7	425	3,621.2	1116	10,479.4
Proceedings Discussions	44	136.0	174	470.3	102	286.1	193	443.3	515	1,335.7
Book Reviews	81	138.2	328	624.6	272	513.9	244	478.3	925	1,755.0
Annual Reports and News Notes	—	366.8	—	476.4	—	239.7	—	322.0	—	1,404.9
Advertising	—	1.0	—	3.5	—	4.0	—	79.5	—	88.0
TOTALS	423	3,415.0	1224	7,513.5	864	6,116.7	1263	9,198.8	3774	26,244.0

the first period. During the second period the number of notes exceeded the number of articles, the number of proceedings papers increased relative to the number of articles, the number of discussions jumped to the 1:2 ratio with proceedings papers that it has enjoyed during the last three periods, and the number of book reviews quadrupled. In the third period the number of notes decreased but in the fourth period they again increased in importance. Throughout both periods the number of book reviews decreased. Considerably more space was given to advertising in the postwar period than in earlier years.

An analysis of the various contributions, not including book reviews, indicates that the 2,849 contributions came from 1,394 different individuals.[5] Included in the 2,849 contributions are 154 contributions with two authors and 20 contributions with three or more authors.

Subject Matter

As a part of this study, all of the contributions were classified according to subject matter and assigned to the 22 classifications used in Table 2. Although this classification is clearly subjective, it is felt that it is reasonably representative of other classification systems that might have been used.

Each of the subject matter fields is listed in the order of its total number of contributions. Percentage contributions of the various fields also are shown for the full 35 years and for each of the four time periods. This tabulation indicates some shifts in the total emphasis given to various subject fields. In the first period farm management was by far the most important subject from the standpoint of total contributions. In the second period the leadership shifted to land economics, marketing, and

[5] This figure includes all single authors and co-authors.

agricultural policy. In the third period land economics and agricultural policy accounted for the largest number of contributions, and in the fourth period agricultural policy and marketing received more attention than any other subjects. This analysis indicates that some subjects such as agricultural policy, production economics, consumer demand, and economic theory tended to receive more and more attention in the JOURNAL while some of the more traditional subjects such as farm management, land economics, and agricultural finance now receive proportionately less attention than in times past.

The contributions in each subject matter field were sorted by type and then divided into two groups—voluntary contributions published as articles and notes, and solicited proceedings papers and discussions. Comparison of these two groups indicates that voluntary contributions account for around two-thirds of the published items in some subject matter fields such as foreign agriculture, production economics, and economic theory.

TABLE 2. CLASSIFICATION OF CONTRIBUTIONS ACCORDING TO SUBJECT MATTER BY TIME PERIOD, 1919–1953

Subject Matter	Total contributions	Total Page Length	Number of Contributions Expressed as Percentage of Total Contribution for Each Time Period			
			1919–1928	1929–1938	1939–1945	1946–1953
Totals Number	2849	22,996.1	342	896	592	1019
Percent	100	100	100	100	100	100
Agricultural Policy	13.9	15.8	10.2	11.3	14.7	17.2
Land Economics	12.7	12.5	7.0	18.4	14.7	8.2
Marketing	10.7	9.4	7.9	12.5	6.9	12.2
Farm Management	8.9	8.1	22.5	8.4	8.5	5.1
Foreign Agriculture	6.5	7.3	5.0	7.8	5.2	6.6
Prices	6.5	6.8	6.7	5.2	9.5	5.7
Agricultural Finance	4.7	5.0	1.5	7.4	4.4	3.6
Statistical Studies	3.8	4.0	7.0	2.1	4.9	3.5
Farm Labor	3.1	3.0	2.5	.7	5.2	4.0
Extension	2.8	2.2	4.1	3.6	.7	3.0
General Ag. Econ.	2.6	2.6	2.9	4.5	1.4	1.6
Collection of Data	2.6	2.3	.3	2.2	3.4	3.1
Cooperatives	2.5	2.1	3.8	1.5	1.7	3.3
Outlook	2.5	2.5	4.4	1.5	2.2	2.8
International Trade	2.3	2.7	2.1	1.5	3.7	2.5
Production Econmics	2.3	3.0	.9	.6	1.2	5.0
Teaching Ag. Econ.	2.3	1.5	3.8	1.3	2.9	2.3
Consumer Demand	2.0	2.1	.3	1.9	1.9	2.8
Economic Theory	1.8	2.2	.3	1.8	1.5	2.4
Technolology	1.6	1.7	1.5	.8	.7	2.9
Rural Sociology & Development	1.3	1.2	2.1	1.8	.8	1.0
Miscellaneous	2.6	2.0	3.2	3.2	3.9	1.2

At the other extreme, a high proportion of the contributions dealing with extension, marketing, agricultural finance, outlook, international trade, general agricultural economics, and cooperatives were solicited.

Some attention also was given to the percentage distribution of the contributions in each subject matter field by time periods. High proportions of the contributions dealing with general agricultural economics, agricultural finance, and land economics appeared during the second time period. On the other hand high proportions of those dealing with production economics, consumer demand, agricultural policy, outlook, and cooperatives appeared during the fourth time period.

When the subject matter groups reported in Table 2 are subclassified by both type and time period, it appears that the increasing importance of some fields such as marketing and outlook may be credited largely to the emphasis given these subjects in proceedings contributions. At the other extreme, most of the recent decline in the importance of land economics may be attributed to a decrease in the number of proceedings papers and discussions dealing with this subject matter area. This subclassification also indicates that no articles or notes dealing primarily with extension problems were published during either of the last two time periods.

Needless to say, the classification of contributions according to subject matter provided a far from easy task. Many contributions involved more than one subject matter field. Each contribution was classified according to the field to which it gave most emphasis, but a record was kept of the classifications involved in those contributions that dealt with more than one subject matter field.

The following cross-classifications appeared most frequently:

Agricultural Policy–Land Economics	96 times
Agricultural Policy–Prices	91
Collection of Data–Statistical Studies	58
Agricultural Policy–Farm Management	48
Prices–Statistical Studies	46
Farm Management–Production Economics	43
Foreign Agriculture–Land Economics	38
Agricultural Policy–International Trade	37
Agricultural Policy–Foreign Agriculture	37
Farm Management–Extension	34
Agricultural Policy–Agricultural Finance	34

General Source of Contributions

As a part of the classification process, consideration was given to the location and professional connections of each of the contributing authors. With these data it is possible to indicate the relative importance of the contributions from each of the sources listed in Table 3 and to indicate

both the types and the number of contributions made in each time period.

The various land grant institutions have accounted for approximately half of the total contributions. Interestingly enough, they contributed more than half of the notes and proceedings discussions but slightly less than their proportionate share of the articles and papers. The non-land grant universities, the Bureau of Agricultural Economics, and foreign sources made a somewhat larger proportionate contribution of articles and notes than of proceedings papers and discussions. The reverse situation applies to the contributions from other government agencies and other American sources.

In each of the four time periods the land grant institutions accounted

TABLE 3. CLASSIFICATION OF CONTRIBUTIONS ACCORDING TO GENERAL SOURCE BY TYPE AND TIME PERIOD, 1919–1953

General Source		Number of Contributions by General Source Expressed as a Percentage of Total Contributions for Each Type				
		Regular Articles	Notes	Proceedings Papers	Proceedings Discussions	Total Number of Contributions[a]
Totals	Number	735	513	1144	521	2,913
	Percent	100	100	100	100	
Land Grant Institutions		44.8	55.6	45.6	53.2	1,413
Non-Land Grant Universities		14.2	13.3	6.8	6.7	285
Bureau of Agricultural Economics		17.9	14.2	16.1	11.1	447
Other Government Agencies		10.8	7.8	15.0	10.9	348
Other American Sources		6.7	3.5	13.5	13.1	290
Foreign Sources		5.6	5.6	3.0	5.0	130

General Source		Number of Contributions by General Source Expressed as a Percentage of Total Contributions in Each Period				
		1919–1928	1929–1938	1939–1945	1946–1953	Total Number of Contributions[a]
Totals	Number	342	913	598	1,060	2,913
	Percent	100	100–	100	100	
Land Grant Institutions		49.1	48.8	47.8	48.4	1,413
Non-Land Grant Universities		6.1	10.0	9.0	11.2	285
Bureau of Agricultural Economics		12.9	14.9	18.7	14.6	447
Other Government Agencies		12.3	11.4	15.4	10.4	348
Other American Sources		16.7	9.5	7.1	9.8	290
Foreign Sources		2.9	5.4	2.0	5.6	130

[a] These totals have been adjusted upward to give recognition to all cases of co-authorship and co-sources. As previously indicated the unadjusted total was 2,849.

for around 48-49 percent of the total contributions published. When the data on contributions by sources reported in Table 3 is subclassified by both type and time period it appears that the proportion of the articles contributed by the land grant institutions dropped from 53 and 50 percent, respectively, in the first two periods to 41 percent in the third and fourth periods. During the postwar period almost 42 percent of the contributions and 22 percent of the articles came from non-land grant universities. During the war the Bureau of Agricultural Economics and the other government agencies contributed a higher proportion of the articles and proceedings papers than usual. Contributions from foreign sources dropped off during the war period but increased again after the war.

Table 4 shows the cross-relationship between subject matter and source. Approximately half of the contributions from land grant institutions are found fairly evenly distributed between the four fields of agricultural policy, land economics, marketing, and farm management. Over the full 35-year period the non-land grant universities gave their greatest emphasis in contributions to agricultural policy; the Bureau of Agricultural Economics to land economics; the other government agencies to agricultural policy, land economics, and marketing; other American sources to agricultural policy and marketing; and the foreign sources to foreign agriculture.

A time period breakdown not reported here indicates that the major emphasis with the land grant institution contributions shifted from farm management in the first period to land economics in the second, agricultural policy and land economics during World War II, and agricultural policy and marketing in the postwar period. The subject matter emphasis in the contributions of the other government agencies closely paralleled those of the land grant institutions. The non-land grant universities gave their first emphasis to prices and then shifted to agricultural policy in the last three periods. A fourth of the BAE contributions in the first period dealt with statistical studies but in each of the periods that followed the BAE gave top emphasis to land economic problems.

Contributions by Institutions

Contributions from 107 colleges and universities were published in the JOURNAL. Table 5 lists the top 19 institutions—those with 25 or more contributions—in the order of their total number of contributions. Minnesota, Cornell, and Wisconsin were the top contributors in the first time period. California, Minnesota, and Iowa State were the top three in the second period. Iowa State was far and away the top contributor during the third period, California and Illinois being tied for second place. In the fourth period Iowa State again led the list but this time it was followed rather closely by Chicago, Wisconsin, and California.

TABLE 4. CLASSIFICATION OF CONTRIBUTIONS BY GENERAL SOURCE ACCORDING TO SUBJECT MATTER

Subject Matter	Number of Contributions in Each Field						
	Total* Contribution	Land Grant Institutions	General Sources			Other American Sources	Foreign Sources
			Non-Land Grant Universities	Bureau of Ag. Econ.	Other Govt. Agencies		
Totals—Number	2849	1383	279	433	342	283	129
Agricultural Policy	397	179	64	44	61	45	4
Land Economics	361	178	25	77	55	23	3
Marketing	304	168	23	26	40	38	9
Farm Management	254	166	9	32	24	16	7
Foreign Agriculture	185	35	27	16	11	16	80
Prices	184	88	24	30	20	18	4
Agricultural Finance	134	61	8	19	24	21	1
Statistical Studies	108	43	8	45	3	9	0
Farm Labor	87	48	16	7	10	4	2
Extension	81	55	0	2	14	9	1
General Ag. Economics	74	32	7	16	6	11	2
Collection of Data	73	16	3	21	16	16	1
Cooperatives	71	32	6	0	9	18	6
Outlook	70	32	9	15	1	12	1
International Trade	68	19	12	11	13	7	6
Production Economics	66	42	3	20	1	0	0
Teaching Ag. Economics	65	49	5	5	2	4	0
Consumer Demand	58	28	8	9	11	2	0
Economic Theory	50	34	5	8	2	1	0
Technology	46	23	3	10	5	3	2
Rural Sociology and Development	38	15	7	6	9	1	0
Miscellaneous	75	40	7	14	5	9	0

* These are unadjusted totals. Articles involving more than one source were credited to the location of the senior author, or in the case of joint employees, to the first named source.

Comparison of the contributions of the various institutions by time periods indicates that several institutions have risen in importance as contributors in recent years. Chicago, Michigan State, North Carolina State, Pennsylvania State, Purdue, and Stanford may be listed as notable examples. In the case of some of these institutions this trend is particularly noticeable during the last five-year period.

In the second section of Table 5 the contributions of the 19 institutions are classified by type. This tabulation indicates that a high proportion of the contributions from Harvard, California, and Iowa State were non-solicited. On the other hand a high proportion of the contributions from Cornell, Wisconsin, Illinois, Ohio State, and North Carolina State were proceedings contributions.

Individual Contributors

As has been mentioned, the 2,849 contributions published in the JOURNAL represent the work of 1,394 different authors. Of this total 479

were authors or joint authors of two or more contributions. One hundred twenty authors had five or more contributions and 44 may be credited with a total of 10 or more. Table 6 lists the 22 individuals who have had 15 or more contributions (not including book reviews) published in the JOURNAL.

Professor John D. Black, who stands out as the top contributor to the JOURNAL had 53 contributions or more than the combined total for any

TABLE 5. CLASSIFICATION OF CONTRIBUTIONS BY TIME PERIOD AND BY TYPE FOR EDUCATIONAL INSTITUTIONS WITH 25 OR MORE CONTRIBUTIONS

Institution	Contributions by Time Period				Total Non-Proceedings	Total Proceedings	Total Number of Contributions
	1919–1928	1929–1938	1939–1945	1946–1953			
Iowa State	14	42	59	55	97	73	170
Minnesota	22	43	24	37	65	61	126
California	5	47	28	45	72	53	125
Wisconsin	17	38	17	48	44	76	120
Cornell	20	40	17	33	25	85	110
Illinois	13	27	28	29	35	62	97
Harvard	5	40	20	22	59	28	87
Chicago	2	13	5	51	39	32	71
Kansas State	12	25	6	9	21	31	52
Purdue	4	13	8	25	19	31	50
Stanford	9	8	14	19	27	23	50
Ohio State	10	16	10	6	9	33	42
North Carolina State	1	7	7	25	7	33	40
Michigan State	2	3	6	27	18	20	38
Kentucky	6	11	11	10	15	23	38
Montana State	1	13	9	14	19	18	37
Missouri	1	15	13	5	17	17	34
Texas A. & M.	4	4	7	12	14	13	27
Pennsylvania State	3	8	0	16	9	18	27
							1341*

* These totals are adjusted upward to give each institution full credit in cases involving co-authorship.

two other individuals.[6] During the first time period Professors Hibbard and Warren and Dr. Taylor were the top contributors. In the second period Professors Black, Wehrwein, Benedict, Grimes, and Waite had more than ten contributions each. In the third period the lead was held by Professors Black, Hammar, and Benedict. During the postwar period, six

[6] Professor Black had more articles and notes than any other contributor and he also ranks high as a contributor to the proceedings issues. His contributions have been divided between 16 of the 22 subject matter fields listed. (A survey of other authors indicated that some authors have written in several fields while others have contributed in one.) Five of Professor Black's contributions were co-authored with other individuals.

individuals—Heady, Black, Schultz, Gale Johnson (14), Wilcox, and Willard Cochrane (11)—had ten or more contributions.

The classification of individual contributions by type indicates that Black, Wilcox, Shepard, and Heady were the top contributors of articles, and that Black, Waite, and Shepherd stood among the top contributors of notes. Henry C. Taylor was the leading contributor of proceedings papers. Professors Case, Grimes, Schultz, Wehrwein, and Hibbard were

TABLE 6. DISTRIBUTION OF CONTRIBUTIONS BY TYPE AND TIME PERIOD FOR AUTHORS WITH 15 OR MORE CONTRIBUTIONS

Author	Total Number of Contributions	Distribution According to Type				Distribution According to Time Period			
		Regular Articles	Notes	Proceedings Papers	Proceedings Discussions	1919–1928	1929–1938	1939–1945	1946–1953
John D. Black	53	17	19	10	7	5	19	14	15
Geoffrey Shepherd	24	11	6	4	3	0	8	7	9
Theodore W. Schultz	23	7	2	10	4	0	5	4	14
Walter W. Wilcox	23	13	3	3	4	0	6	5	12
M. R. Benedict	23	9	2	8	4	1	12	8	2
H. C. M. Case	22	5	2	13	2	7	8	5	2
W. E. Grimes*	22	2	1	12	7	7	12	2	1
Frederick V. Waugh	21	7	4	7	3	2	7	6	6
George S. Wehrwein*	21	1	4	10	6	4	15	2	0
Conrad Hammar	18	7	3	4	4	0	9	9	0
Benjamin Hibbard	18	4	1	10	3	11	7	0	0
O. B. Jesness	18	3	3	9	3	3	5	7	3
O. C. Stine	18	0	2	10	6	3	9	2	4
H. C. Taylor	18	3	0	14	1	9	5	4	0
Warren C. Waite*	18	2	8	7	1	1	11	4	2
H. E. Erdman	17	4	4	6	3	3	8	3	3
Earl O. Heady	17	10	1	6	0	0	0	1	16
G. F. Warren*	17	4	0	9	4	10	7	0	0
Sherman E. Johnson	15	4	2	9	0	0	4	7	4
W. G. Murray	15	1	4	7	3	0	6	6	3
E. G. Nourse	15	4	0	9	2	7	6	1	1
George A. Pond	15	4	3	4	4	3	5	4	3

* Deceased.

also popular contributors of papers at the annual meetings. The top 22 contributors were responsible for 196 articles and notes as compared with 255 proceedings contributions. Of the 22 authors listed, only seven had more articles and notes than proceedings contributions. In passing it may be noted that these top contributors have also authored numerous books, bulletins, and articles which have appeared in other journals.

As a part of the individual contributor analysis, information was compiled concerning the contributions of the 45 individuals elected to

the presidency of the American Farm Economics Association and its predecessor the American Farm Management Association. Of these 45, 42 had at least one contribution and 30 had 6 or more contributions. Included among the contributions are the three presidential addresses made by Presidents Billings, Fain, and Jeffers.

Analysis of the contributions by the men honored with the presidency of the Association indicates that many of these individuals have contributed few articles to the JOURNAL. Seven contributed no articles or notes while ten contributed only one. Three contributed no proceedings papers while three others contributed only one. On the other hand, 16 of the top 22 contributors have served as president. More than two-thirds of the contributions by the presidents have come as proceedings papers.

In conclusion, it may be noted that this discussion has been limited largely to a report on the factual findings of a study of the content of the JOURNAL during its first 35 years. More analysis could be made of a number of problems such as the quality of the contributions, the changes that may be attributed to rotating editorship, the effect of the editor's location upon the contributions from his institution and the reasons why some sources or individuals have or have not made contributions. These avenues of analysis have been avoided because of the obvious difficulties and pitfalls that they suggest.

SOME INTERRELATIONSHIPS OF ECONOMIC AND AGRONOMIC CONCEPTS*

JOHN C. REDMAN AND STEPHEN Q. ALLEN
University of Kentucky

CONCEPTS are essential to all fields of science and an understanding of them is vital because from these concepts many decisions or conclusions are made. Dependence of economic relationships upon the biological relationships found in such sciences as agronomy makes it necessary that farm economists whose work is related to such disciplines understand the relationships as conceived by workers in those fields.

Need for Study

This study relates a few of the concepts used by economists and agronomists by pointing out some agronomic concepts and examining them within the framework usually employed by economists. The concepts held by an individual pertaining to input-output relationships are very influential in making estimates of the expected response to yield-influencing factors and the optimum level of output. They are also influential in deciding how certain inputs or yield-influencing factors should be combined. For example, if one conceives of the marginal rate of transformation of a factor into a product as being constant, the optimal output would be either unlimited production or no production depending upon the factor-product price ratio faced. On the other hand, if the concept is one of a changing marginal rate or transformation, the optimum level of output would result when the rate of transformation is equal to the factor-product price ratio faced. Also, if two factors are regarded as being perfect complements, the factor-price ratio does not influence the combination for a given production. Thus, it is important that appropriate concepts be used in order to determine the most profitable combination and use of yield-influencing factors. In this paper no particular attention will be devoted to the concept of product-product relationship although it is extremely valuable in studying such problems as crop rotations.[1]

Agronomic Production Functions

One of the primary tasks of agronomic research is to quantify the functional relationships among the inputs of productive services and the out-

* The investigation reported in this paper is, in part, in connection with a project of the Kentucky Agricultural Experiment Station and is published by the permission of the director.

[1] For a discussion of input-output and product-product relationships, see Earl O. Heady and W. D. Shrader, "The Interrelationship of Agronomy and Economics in Research and Recommendations to Farmers," *Agronomy Journal*, October, 1953.

put under certain conditions. These functions, given us by the agronomists, are descriptive of the physically feasible organizations of services necessary for a given production. The yield of crops is a function of a number of factors. Some of the factors are (1) the inherent ability of the plant, (2) the climatic factors or those which act upon the plant through the atmosphere, (3) the edaphic factors or those operating through the soil, and (4) the biotic factors or those resulting from the association with other plants or animals. Since these groups of factors are complementary, the influence of one group on yield will depend upon the level at which the other groups exist. However, there has been quite a difference of opinion among agronomists as to which factors influence yields and to what extent their influences may be exerted.

A wide difference of opinion has existed among agronomists as to the function of the various yield influencing factors and as to what constitutes the true nutrition of plants.[2] Nitre, water, fire (phlogiston), air, and earth (terrestrial matter) are some of the materials that have been considered to be the food of plants at various times.[3]

Currently most agronomists appear to accept the mineral theory first proposed by Justus von Liebig that the increase in yield of a plant is brought about by various inorganic elements in the soil and the atmosphere. It is recognized, however, that the true food of plants is not merely the inorganic factors, but that green plants are able to combine and transform them into food capable of being used in the construction of plant cells by the process of photosynthesis, using the energy derived from the sun.

Complementary and Linear Relationships

An early concept of a production function is indicated in Liebig's "law of the minimum" which has had much influence on the thinking in agronomy and perhaps in farm economics. The concept holds that the yield of any crop is governed by any change in the quanity of the scarcest factor called the minimum factor and as the minimum factor is increased the yield will increase in proportion to the supply of that factor until another factor becomes the minimum. If another factor, not at the minimum, is increased or decreased the yield would not be affected.[4] Thus, the yield curve or the total physical product (TPP) would rise at a constant rate and then would become horizontal at the point where the

[2] For an account of early thinking in this respect, see Stephen Q. Allen, "Economic and Agronomic Concepts with Respect to Inputs and Outputs", Unpublished Master's thesis, University of Kentucky, 1953.

[3] Jethro Tull, *Horse Hoeing Husbandry* (London: William Cabbott, 1829) p. 46.

[4] Justus von Liebig, *The Natural Laws of Husbandry* (New York: D. Appleton and Co., 1863) p. 207.

limiting effects of the minimum factor are experienced (Fig. 1). Regardless of how much of the other factors are applied, the yield will not increase until the minimum factor is increased. This concept used by Liebig means that yield is a linear function of the minimum factor up to its limit in quantity. In addition, the fact that the concept recognized that no additional product would be forthcoming due to addition of other factors, indicates that the factors are perfect complements and no possibility of factor substitution exists. Thus, the price ratio as a choice indicator would play no part in determining the optimum combination for a given output.

FIG. 1. Relationship between yield and quantity of minimum factor according to Liebig.

While the authors haven't been able to determine what influence the law of the minimum concept has had on the early farm economists, it is to be noted that many of the early farm management men came from the field of agronomy and the subsequent publications often contain various illustrations such as a water barrel with the staves representing the different factors affecting farm profits. The shortest stave limits the level of water or profits. This and similar illustrations represent essentially the same concept advanced by Liebig which recognizes constant returns to the variable or limiting factor and denies the possibility of resource or factor substitution. It is, of course, a rare circumstance when a resource can't be partially substituted for another resource at least within narrow limits. When the factor-product price ratio is considered with regard to such functions, the farmer would apply all of the minimum factor he could obtain and achieve unlimited production if the marginal factor cost (MFC) is less than the marginal value product (MVP), or he would not

apply any and achieve no production if the marginal factor cost is greater than the marginal value product.

Diminishing Returns

Liebig's idea of simple proportional relationship of plant yield to the plant nutrient applied does not fit the observations with respect to plant response. Lawes and Gilbert, in their work at Rothamsted, modified Liebig's ideas by obtaining a response but at a decreasing rate when the fertilizer applied exceeded a certain amount.[5] This demonstrated that the law of diminishing returns operates in fertilizer practice.

Wollny, in an effort to test the correctness of the law of the minimum more thoroughly than had been done before rather than to determine the behavior of yield increase, concluded that with the addition of nutrients a rise occurs in the productive powers of a plant which is at first progressive and then becomes gradually smaller up to a certain limit, beyond which a further increase in the supply of nutrients causes a reduction in yield.[6]

Tull conceived yield as an increasing function of the inputs, such as manure or tillage. He thought that tillage could be used in place of manure and advocated multiple tillage operations by saying that the "third, fourth, and every subsequent ploughing may be of more benefit and less expense than any of the preceding ones."[7] The fact that Tull invented and manufactured tillage machinery may have biased his opinion in the direction of increasing returns to tillage operations.

The first thorough study of plant response to a growth factor was made by Hellriegel in the 1880's when nitrogen was added to an ample amount of other factors in the production of barley.[8] The first increment of nitrogen produced an increase in yield but second and third increments produced larger yield increments than could be expected with Liebig's idea of constant returns. Further applications of nitrogen gave less response in yield, thereby creating a sigmoid yield curve which followed that as viewed by economists many years earlier.

The yield curves established by various experiments were of similar shapes and this suggested to Mitscherlich of the Koenigsberg Experiment

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[5] E. J. Russell, *Plant Nutrition and Crop Production* (Berkeley: University of California Press, 1926) p. 28.

[6] W. J. Spillman and E. Lang, *The Law of Diminishing Returns and the Law of the Soil* (New York: World Book Co., 1924) p. 100 (Quoted from Ewald Wollny's "Untersuchungen uber den Einfluss der Wachstumsfaktoren auf das Produktionsvermogen der Kulturpflantzen", *Forschungen auf dem Gebiete der Agrikulturophysik* 1897-98, p. 105-106.

[7] Jethro Tull, *Horse Hoeing Husbandry* (London: William Cobbett, 1829).

[8] E. J. Russell, *Soil Conditions and Plant Growth* (New York: Longmans, Green and Company, 1950).

Station in Germany that they can be expressed by a mathematical equation to indicate in a quantitative way how plant nutrients promote crop yields. Mitscherlich assumed that a crop should produce a maximum amount if all conditions were ideal, but if any essential growth factor is deficient, there would be a corresponding shortage in the yield. In addition, he suggested that the increase in yield caused by an addition of an unit of the deficient factor would be proportional to the decrement from the maximum yield, giving us the well-known expression,

$\frac{dy}{dx} = (A - y)\ C$, with y as the yield when x is the quantity of growth factor present, A is the maximum yield that could be produced by increasing indefinitely the amount of growth factor, and C is a constant or the proportionality factor. This equation will not give a sigmoid curve but one which is concave to the axis representing the nutrient supply. The proportionality factor is a constant for each growth factor independent of other conditions, such as soil or crop grown. If this were true, yield responses could be predicted easily from different quantities of growth factors or plant nutrients. This prediction is one of the most difficult problems facing the farmer and he certainly needs a method by which he can come reasonably close in estimating possible yield from applying growth factors.

However stimulating and promising a development Mitscherlich's equation was, interest in improving it has faltered generally because the response of a crop to a nutrient depends upon the level of other nutrients or growth factors present. While it is probably true that the equation does not exactly express the relationship found at all times and conditions, it is most unfortunate that it is all but neglected. A logical equation that can be used satisfactorily on experimental results would make it possible to estimate the yield from any quantity of growth factor in question the only data needed being those required to determine accurate values for the constants of the equation.

In criticism of early work of Mitscherlich, it was pointed out that yield curves of a particular growth factor must be profoundly modified by the other yield influencing factors. Baule recognized this and enlarged upon Mitscherlich's equation to include the interaction of all yield influencing factors. He assumed that each of the yield influencing factors acts in accordance with Mitscherlich's ideas and that the final yield is the product of all the factors working together. Each nutrient exhibits a definite percentage sufficiency in terms of maximum effect which it could exert if present in an optimum amount. Thus, equal increments of a fertilizer would always give increments of yield which are the same percentage of

the amount by which the actual yield fails to equal the maximum yield.[9] The general yield equation according to Baule becomes $y = A(1-10^{-c_1x_1})(1-10^{-c_2x_2}) \ldots (1-10^{-c_nx_n})$ with y as the yield, A as the maximum obtainable yield, c_1, c_2, c_n the constant effect factors of x_1, x_2, x_n, the variable growth factors. This is essentially the same as the Spillman equation.

Mitscherlich incorporated the ideas of Baule into his theory of yield response which indicates that plant growth and yield depend upon all the yield influencing factors working together; no one factor can be missing. Not only should all factors be present but they should be in balanced proportions so that they may mutually strengthen and support each other, as some of the potency of a factor will remain dormant in the absence of adequate support. This concept suggests that a high degree of complementarity is present among the factors in the production of plants.

The implication of Baule's ideas regarding simultaneous influence of several growth factors on the yield response curve can be noted as (1) the more growth factors one improves step by step, the later will the highest rate of yield increase be reached, and the higher the point of inflection will be on the yield curve, (2) the fewer the growth factors one adds at the same time, the sooner the maximum rate of yield increase is reached and lower the inflection point will lie on the yield curve, and (3) with the improvement of only one factor, the most rapid rate of yield increase occurs at the beginning of the curve and the rate of increase falls off more and more.[10] The level at which other factors are fixed would determine the yield response that can be expected from using one Baule unit[11] of yield influencing factor (Fig. 2). For instance, if several growth factors are used in production and only one, X_1, is permitted to vary with all others, X_2, X_3, X_4, fixed at the low level of one Baule unit, the response to X_1 (Curve A in Fig. 2) will not be as great as it would be if an additional factor, X_2, is varied along with X_1 with only X_3 and X_4 fixed (Curve B in Fig. 2). If all of the factors, X_1, X_2, X_3, X_4, are varied, the total yield response to these factors (Curve D in Fig. 2) would be near a maximum at 10 Baule units. These relationships seem to be consistent with the concepts employed by production economists.

In an effort to describe the more exact nature of crop response to plant nutrients, Spillman of this country developed simultaneously with Mitscherlich of Germany an equation which can be used in estimating the effect of growth factors on yield. Spillman arrived at his equation, $y = A(1 - R^x)$, by assuming that the successive equal increments in

[9] Spillman and Lang, *op. cit.*, p. 143.

[10] Spillman and Lang, *op. cit.*, p. 147.

[11] A Baule unit is the amount of a yield influencing factor necessary to produce one half the maximum yield when other yield influencing factors are at their optimum.

fertilizers tend to constitute the terms of a decreasing geometric series, while Mitscherlich developed his equation, $y = A(1-e^{-kx})$, by assuming the slope of the yield curve at all points is proportional to the amount of increase theoretically yet possible from the use of the nutrient in question. The expression e^{-k} in Mitscherlich's formula the R in Spillman's formula both indicate the ratio of any two consecutive increments in yield due to consecutive unit increments in fertilizer applied. Thus, the equations are

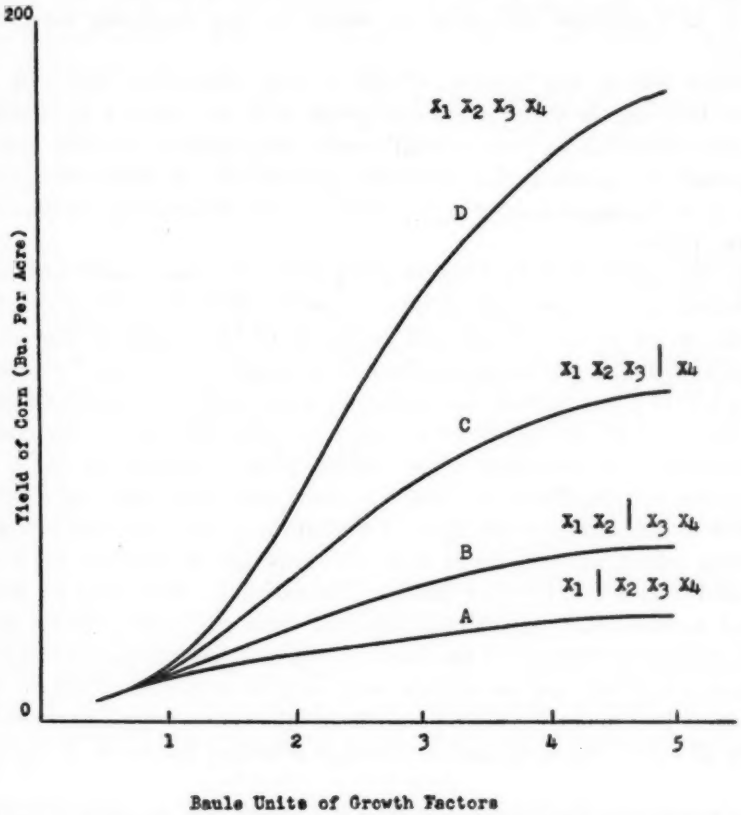

FIG. 2. Simultaneous Influence of Several Growth Factors on the Yield of Corn When the Fixed Factors are at Low Levels.

essentially identical, and neither allows for a stage of increasing marginal returns (Stage I) nor for a stage of negative marginal returns (Stage III). However, the proportionality factor in Spillman's formula was assumed to be dependent upon the conditions encountered such as soil and climate while Mitscherlich, as pointed out previously, regarded the proportionality factor as being independent of such conditions. Some experi-

ments indicate a curve sigmoid in shape and Russell[12] suggests that it is possible that the curve is usually sigmoid, but that the point of inflection is so near to the origin that it is commonly missed. Often it is necessary to have soils extremely deficient in phosphorus, for example, to demonstrate a sigmoid shaped curve.[13] By the use of the Spillman formula, $Y = A(1 - R^x)$, or its modification, $Y = M - AR^x$, when applied to that part of the sigmoid shape curve lying beyond the point of inflection, an excellent fit may be obtained. To obtain maximum net income, the problem is to determine the point at which to stop applying the growth factor.[14]

Pfeiffer was of the opinion, which he later discarded, that with continued increase in yield a turning point will be reached at which an absolute reduction in yield would result. Mitscherlich claimed, and was supported by Spillman, that when the quantity of a fertilizer becomes so large as to be injurious to the plant the law of diminishing increment no longer applies.[15]

The economist must be wary in using these and other mathematical relationships on response data of farm crops. As inferred in this paper there appears to be no well-developed theory of plant growth to warrant the assumption that a particular mathematical function is a "true" expression of the law of plant growth. An economist often seeks an equation that will give the "best fit" to a given set of response data. This provides a numerical expression of judgment about future plant responses to inputs and formulates the conditions to which various cost and price ratios can be applied to determine profitability. A limitation of this objective is that the equation which fits one set of data well may not fit another set of data obtained under similar (not identical) conditions. This may be due to several reasons such as selection of data from different portions of the same production surface or the level of the fixed factors may be different for each set of data and use of data with large experimental error. Another limitation lies in an element of arbitrary decisions which is present in nearly all curve fitting operations through selecting the limits of the data,

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[12] E. J. Russell, *Soil Conditions and Plant Growth* (7th Ed.; New York: Longmans, Green and Co., 1937) pp. 134-136.

[13] L. A. Dean and Maurice Fried, "Soil-Plant Relationships in the Phosphorous Nutrition of Plants" (U. S. Department of Agriculture, Beltsville, Maryland) p. 7.

[14] For an application of the Spillman production function in analyzing the alfalfa yield response to phosphate fertilizer, see James L. Pascal, *Economic Analysis of Alfalfa Yield Response to Phosphate Fertilizer*, F.M. 104 (Washington: Bureau of Agricultural Economics, June 1953). Also, for explanation of the techniques and procedures in the use of the Spillman function in estimating yield response to plant nutrients, see D. B. Ibach and S. W. Mendum, *Determining Profitable Use of Fertilizer*, F.M. 105 (Washington: Bureau of Agricultural Economics, June 1953).

[15] Spillman and Lang, *op. cit.*

or the segment of the production surface, and the choice of algebraic functions. Mathematical formulations often become misleading when they convey the impression of strict objectivity.

More basic than the problem of merely searching for the algebraic function that will give the "best fit" is the problem of finding a relationship that will contribute to the building of a well-defined theory of plant growth. Here the interest lies not merely in the goodness of fit except on well-defined assumptions underlying the growth response, but in finding an equation which will "fit" the data over the whole range that will lead to an inductive formulation of a theory of plant growth. Such a discovery would provide a basis for determining deductively a plant response function.[16] In absence of such a discovery, it may be desirable to fit logical algebraic curves to response data covering wide ranges and then obtain some frequency distribution of curves over time.

Interaction and Complementary Relationships

Liebig's law of the minimum implies that if two factors are limited, the addition of one would have no effect on the yield. Or, to put it another way, by combining the two growth factors the same production can be had with much less quantity of factors. Such a relationship is known to the agronomist as factor interaction whereas the economist likes to think of it as factor complementarity; but the problem remains to determine the degree of interaction or complementarity. By that, it is meant that economists and agronomists are concerned in determining if they are perfect complements as Liebig suggested or something less than perfect. If they are less than perfect complements then growth factors are partially substituted for others but, of course, at a decreasing rate for a given level of production. This may occur only within a small range.

Two factors are said by agronomists to have a positive interaction if the response of the crop to both factors or variables together is larger than the sum of the responses of each separately, no interaction if the response to both is just equal to sum of the responses of each, and negative interaction if the response is less than the sum of each separately.[17] The economist would view all of these relationships as being complementary with various degrees. It is important to know the degree of

[16] An example of such a discovery in another field was by Mendel who published in 1866 his observations and conclusions after years of experimentation. He established that hereditary traits are transmitted according to the laws of chance and this led to the founding of the science of genetics.

[17] Some examples of experimental results which illustrate these relationships are the fertilizer experiments made at Rothamsted between 1938 and 1945 studying the response of potatoes to nitrogen and potassium; other studies include relationship between water supply and nitrogen made by von Sellhorst of Germany and a similar one by Gregory, Crowther, and Lambert in the Sudan.

complementarity or substitution so an optimum combination of factors can be attained by equating the marginal rate of substitution and the ratio of the factor prices. Factors can be partial substitutes and partial complements in production of a given quantity if the possibilities of combination lie between the two extremes of fixed proportions (perfect complements) and substitutes at a constant rate (perfect substitutes).

Yield of corn can be expressed as function of nitrogen, number of hybrid plants with other factors such as phosphorus, potash, type of soil, etc., fixed at a particular level as indicated by the following notation:

$$Y = f(N, \text{Hybrid Plants} \mid P_2O_5 = 80\#, K_2O = 80\#, \text{Loamy Soil, etc})$$

By applying the data of a well-known experiment[18] to a three-dimensional diagram (Fig. 3), it can be shown that a given yield of corn can be pro-

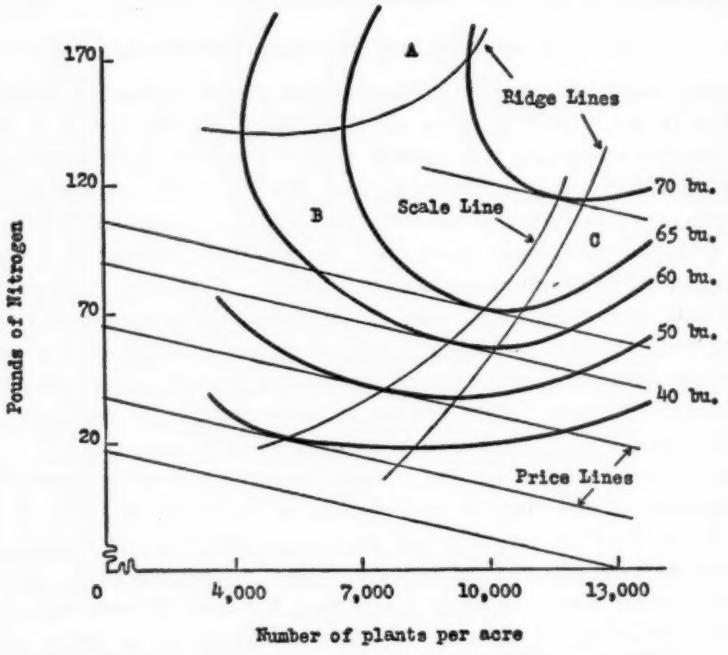

FIG. 3. Relationships in Corn Yield, Nitrogen and Plant Population.

duced by several different possible combinations of nitrogen and plants, and that nitrogen can be substituted within ranges for plant population (seed corn) and vice versa. However, the marginal rate of substitution is not constant as evidenced by a curved product contour. When inputs possess a degree of complementarity, it is necessary to find the optimum

[18] See B. A. Krantz, "Research Points the Way for Higher Corn Yields in North Carolina," *Better Crops with Plant Food*, Vol. 31, No. 2, Feb. 1947.

combination of inputs as well as the optimum use of those inputs. These optima depend upon the ratios of prices expected as choice indicators. Therefore, the optimum combination of nitrogen and number of plants depends upon relative cost of nitrogen and seed corn.[19] The least cost combination or a point on the scale line (expansion path) results when the slope of the product contour at a point is equal to the slope of the price line which expresses the relative quantities of each input that can be purchased with a given outlay of money. The scale line may be located anywhere depending on the price ratio within the area set by the ridge lines which define the area of rational factor use (Area B in Fig. 3). Outside of these confines (Areas A and C) factor use is uneconomic. The quantity of both inputs to use for maximum returns depends also upon the relation between the price of corn and the cost of nitrogen and seed corn combined according to scale line. When there is a degree of complementarity[20] present among growth factors or inputs, it is necessary to increase both nitrogen and plants or all factors simultaneously to the point where the marginal rate of transformation is equal to the combined factor cost-product price ratio in order to produce the most profitable yield, i.e. the optimum point on the scale line.

It is generally agreed among agronomists that plants are not selective in their nutrient intake, and that the growth of a plant may be upset if nutrients are not properly balanced. Soils may be balanced at a low level, high level, or anywhere in between, but may become unbalanced when a nutrient is increased to a high level relative to the others.[21] Willcox suggests that for a soil to be idealy balanced, the nutrients, N, P_2O_5, and K_2O should be in the soil at the ratio of 5 : 2 : 1, regardless of soil or crop to be grown.[22] Others think that the desired balance depends upon the crop to be grown and the soil.[23] Thus, the high analysis fertilizer with 1-1-1 ratio now on the market will not permit flexibility in the use of various nutrients to achieve a given yield.

The idea of balance is concerned with what the economists refer to as proportionality or diminishing returns.[24] The problem of diminishing re-

[19] The nitrogen was priced at 15¢ per pound and seed corn at $12.00 per bushel. Thus, 16 pounds of N was assumed to be equal in value to seed corn necessary to plant 13,000 plants which gave the slope of the price line used in Figure 3.

[20] Agronomists speak of complementarity as just discussed as a significant feature of Liebig's law of minimum concept.

[21] L. J. Turk, R. L. Cook, and J. F. Davis, "Efficient Use of Fertilizers and Lime" (Paper presented at the joint meeting of agronomists with the fertilizer industry, sponsored by the Middle West Soil Improvement Committee, February 20, 1953).

[22] O. W. Willcox, *A B C of Agrobiology* (New York: W. W. Norton and Co., 1937) p. 276-277.

[23] L. M. Turk, *et. al., op. cit.* p. 31-33.

[24] For definition see G. J. Stigler, *Theory of Price* (New York: Macmillan Co., 1952) p. 111.

turns relates to the problem of the proportions in which the inputs are used. As increments of a variable input are added to a larger fixed quantity of other inputs, a point of optimum proportions (balance) is first approached, giving more than a proportional return to the variable input. Then if additional increments are added, the optimum proportion (balance) is passed and less than proportionate returns are realized, giving a decreasing return to the variable input.[25] The agronomist's idea of balance is to keep each nutrient or growth factor in optimum proportion to each other. However, it is recognized that this balance may be possible at high or low level and that diminishing returns to scale in the use of this balance of factors will result.

Most agronomists believe that the "big three" fertilizer elements (nitrogen, phosphorus, and potassium) perform specific physiological functions in the plant and not one of them may be substituted for another. Many experiments indicate, however, that there is at least some degree of substitution among them. Whether this substitution effect is physiologically direct or indirect is apparently not definitely known. It is probable that the use of a larger amount of one factor may cause other factors in the soil that are unavailable to become available to the plant. If the contention of Baule, that each growth factor exerts its influence independently of all other factors and that the total yield will be the product of the influence exerted by each, is valid, this substitution effect is only apparent and no real substitution can exist (biologically).

It is generally known that in the application of a particular nutrient to a crop with other nutrients fixed at designated levels the yield curve will approximate a parabolic or exponential curve in nature.[26] When this is true, there appears to be considerable range in which one nutrient can substitute for another and keep the yield at a constant level at least for a short time. This hypothesis is also supported by a pasture experiment at Kirbyville, Texas.[27] The extent to which substitution can profitably be made depends upon the rate at which one element can replace another in the production of a given yield and the relative price of the nutrients.

A Joint Problem

The economist obviously must seek many of his premises in the territory of other sciences. To have these sciences accept the responsibility

[25] K. E. Boulding, *Economic Analysis* (New York: Harper and Bros. 1948) p. 676.

[26] For a comparison of three different equations see Paul R. Johnson, "Alternative Functions for Analyzing a Fertilizer–Yield Relationship," *This Journal*, Vol. 35, November 1953, pp. 519-529.

[27] As reported by D. B. Ibach, "Interpreting Fertilizer Response for Better Farm Management" (Paper presented at the annual meeting of the American Society of Farm Managers and Rural Appraisers, Chicago, Illinois, December 1, 1952).

of supplying properly formulated premises as needed would be most gratifying to the economist. In the past, economists have been forced to construct some of the concepts without any particular professional competence. For instance, a comprehensive and lucid formulation of the concept of the law of diminishing returns was made by Turgot, a distinguished French physiocrat. This law is essentially a law of technology, but was first discovered and applied by economists, particularly by the classical school. It was borrowed by agronomists and used extensively especially since Spillman, who had a wide background in both agronomy and farm management, made wide use of the concept. However, many recommendations still need to be made within the restrictions imposed by this important law. It is not enough to make a recommendation that a farmer in a particular region should use 400 pounds of 6-8-6 fertilizer on his corn without considering the expected yield and the cost-price relationships. The farmer would have no basis for determining whether or not this is the most profitable amount to use.

Agronomic science has risen to a high level and has provided many possible production functions, especially the factor-product type of relationships. The economist would like to see increased emphasis on the discovery of basic relationships in the behavior of crops and soils. One of the relationships appear to be in need of exploring pertains to the possibility of substitution among growth factors which includes nutrient substitution. The empirical data provided by agronomists embodying such basic relationships as factor-factor, factor-product, and product-product are essential to the farmer in his evaluation of the alternative choices for maximum net returns.

A FERTILIZER PRODUCTION SURFACE WITH SPECIFICATION OF ECONOMIC OPTIMA FOR CORN GROWN ON CALCAREOUS IDA SILT LOAM*

EARL O. HEADY AND JOHN PESEK
Iowa State College

ECONOMISTS and agronomists have long discussed the need for refinements in fertilizer input-output quantities. The early writings of Spillman and Tolley and associates are classics in this respect.[1] More recently, Johnson, Ibach, Pesek and Dumenil, and Heady and Shrader have emphasized the need for greater knowledge of the fertilizer production function.[2]

Even with this long-standing knowledge of the need for improved knowledge of the crop-fertilizer marginal coefficients, relatively little progress has been made. This void exists because of several reasons: (1) Few fertilizer experiments have been designed previously to provide a full array of marginal transformation rates (i.e., the ratio of added crop yield to added fertilizer units) and substitution coefficients (the amount of one nutrient replaced a unit of another nutrient) and to allow refined recommendations on the economic optimum fertilizer use. Economists who have had a prime interest in determining the more profitable usage of fertilizer have had to explore and inventory existing fertilizer rate experiments to find data for use in estimating the relevant production functions. Usually the search has resulted in very little relevant information. On the other hand, the agronomist who controls the experimental design, has been interested largely in variance-type studies to establish response and relate it to soil characteristics rather than to determine the marginal quantities and the optimal use of fertilizer. Agronomists and economists have seldom, if ever, gotten together to design an experiment to provide a full range of marginal quantities needed to compute both the optimum rate of application and nutrient combination. (2) Too little is

* Journal paper J-2539 of the Iowa Agricultural Experiment Station. Projects 1135 and 1099. The authors wish to acknowledge the aid of Wm. Brown and Don Hunter.

[1] Cf. W. J. Spillman, *Use of the Exponential Yield Curve in Fertilizer Experiments*, U.S.D.A. Tech. Bul. 348; W. J. Spillman and E. Lang, *The Law of Diminishing Returns*, World Book Co., New York, 1924, and H. R. Tolley, J. D. Black and M. J. B. Ezekiel, *Input as Related to Output in Farm Organization Studies*, U.S.D.A. Bul. 1277.

[2] Cf. Paul R. Johnson, "Alternative Functions for Analyzing a Fertilizer-Yield Relationship", *This Journal*, Vol. 35. D. B. Ibach and S. W. Mendum, "Profitable Use of Fertilizer", F.M. 105, U.S.D.A. (Mimeo). John Pesek and Lloyd Dumenil, "How Much Fertilizer Pays", *Iowa Farm Science*, April, 1953. Earl O. Heady, "Use and Estimation of Input-Output Quantities", *This Journal*, Vol. 34, and Earl O. Heady and W. D. Shrader, "Interrelationships Between Agronomy and Economics in Farmer Recommendations", *Journal of Agronomy*, November, 1953.

known about the mathematical form and biological basis of the fertilizer production function. After Spillman and Mitscherlich suggested the exponential yield curve it was used quite widely. Still it is known that the exponential function is not appropriate for yield observations which include negative marginal productivities; neither do the assumptions of equal marginal product ratios appear to have, under all conditions, as much biological basis as other algebraic forms of production functions for fertilizer.[3]

Obviously, there is great need, both in terms of fundamental science and practical recommendations, for increased knowledge of the fertilizer production function. The current need is to go beyond (1) the single variable, input-output curve, and (2) a single estimating equation. The full economic potential in fertilizer use can best be determined if experiments include at least two variable nutrients, and perhaps as many as four variables including three nutrients and seed (or moisture) for many crops. Research of this nature needs to be carried on with close cooperation between agronomists and economists all of the way from the technical details of experimental design to final economic recommendations. A study involving two variables is reported in this paper.

Nature of Experiment

This corn experiment was conducted on calcareous Ida silt loam in Western Iowa. The rate of planting was 18,000 plants per acre; nitrogen and phosphorous were the variable elements. Including zero rates, there were nine rates of each nutrient!; a possibility of 81 different N_iP_i combinations. However, since relatively little is known about variance quantities for experiments of this type and the land area was large, the design was modified to exclude some of the possible combinations. The final design is shown in Table 1. All N_iP_i combinations along the borders of the table were included; the northwest-southeast diagonal was completed; the column under $N_i = 160$ pounds was filled in, as was the row for $P_i = 160$; one northwest-southeast diagonal was completed in both the southwest and northeast quadrants of the table. An alternative design would have been to complete all of the N_iP_i cells or possible nutrient combinations with single observations under each. However, the design indicated, with replications for each N_iP_i treatment included, was selected. Lack of knowledge on the degree of uniformity in variance over the surface led to use of the particular design. It provides sufficient observations for the predictions which follow. The sources of nitrogen and P_2O_5 were ammonium nitrate and concentrated superphosphate.

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[3] Similarly, a logarithmic or Douglas-type function cannot apply with both positive and negative marginal products; its assumption of a constant elasticity coefficient seems no more reasonable than other alternatives. See Heady, *op. cit.*

Algebraic Form of Functions

The experimental design allows estimation of a two-variable production function. From it can be estimated (1) the yield isoquant[4] and the corresponding nutrient combination ratios, and (2) response curves and the corresponding marginal products of each nutrient alone with one nutrient variable and the other constant at specified levels (a response curve of elements in varying proportions), or both nutrients varied in constant proportions (a scale line or response curve of elements in fixed proportions). From these several relationships, and their corresponding marginal coefficients, for particular weather and soil conditions, it is possible to

TABLE 1. DESIGN OF EXPERIMENT. EACH x REPRESENTS A SINGLE EXPERIMENTAL PLOT UNDER THE CORRESPONDING N_i LEVEL OF THE COLUMNS AND THE P_i LEVEL OF THE ROWS

P_i[a]	N_i[a]								
	0	40	80	120	160	200	240	280	320
0	xx	xx	xx	xx	xx	xx	xx	xx	xx
40	xx	xx			xx	xx			xx
80	xx		xx		xx		xx		xx
120	xx			xx	xx			xx	xx
160	xx	xx	xx	xx	xx	xx	xx	xx	xx
200	xx	xx			xx	xx			xx
240	xx		xx		xx		xx		xx
280	xx			xx	xx			xx	xx
320	xx	xx	xx	xx	xx	xx	xx	xx	xx

[a] Pounds of P_2O_5 and elemental nitrogen per acre.

predict (1) the combination of nutrients which will minimize the fertilizer cost of any stated yield and (2) the rate of fertilizer application, including both nutrients, which will maximize profits per acre.[5]

Of course, little if any direct substitution of nutrients takes place within

[4] A yield isoquant shows all the possible combinations of two nutrients which will allow attainment of a given yield, as 60 bushels. As a two-dimension graph (see Figure 5) with each nutrient measured on one axis, it forms a contour curve, just as on a topographic map.

[5] The conditions (with two variable fertilizer nutrients F_1 and F_2 and a single crop Y) under which cost is minimized or profit is maximized under the two situations are respectively:

$$(1)\quad \frac{dF_1}{dF_2} = \frac{P_{f2}}{P_{f1}}$$

$$(2)\quad \frac{dY}{dF_i} = \frac{P_{f1}}{P_y}$$

Where P_{f1} and P_{f2} refers to the price per unit of a particular nutrient, P_{f1} refers to the price, including application cost, of the specified nutrient and P_y refers to the price per unit of the crop.

the chemical processes of the plant. "Substitution" takes place mainly as (a) composition of the plant changes or (b) availability of one nutrient in the soil is altered as the quantity of the other increases. Since our yield measurements are in terms of grain, we are concerned only with "substitution" of the latter nature. As long as substitution or replacement of one nutrient by another can take place in this fashion, it is the framework within which the farmer must make decisions. Our "raw data" show, for example, the same yield to be attained with numerous combinations of nutrients. A yield of 127 bushels was obtained under treatments including (a) 160 pounds of P_2O_5 and 160 pounds of N; and (b) 240 of P_2O_5 and 120 of N; five other treatments gave yields within 2.5 bushels of this level. Nutrients served as substitutes in the sense that the same yield level was attained by different nutrient combinations.

Production Functions

A major objective of this study is to derive production functions which include both variable nutrients in the algebraic equation. Such a function defines the production surface and the relevant quantities associated with it. Several alternative algebraic forms of equations were applied to the data. First, single variable regression equations were fitted to the completed rows, columns and diagonals indicated in Table 1. The single variable equations allow prediction of the response curve when one nutrient is variable and the other is constant at the level indicated in the heading of columns or rows respectively. The two-variable production functions allow exactly the same types of predictions; one element can be held constant in the algebraic equation, while the other is varied to derive a response curve of changing proportions. The chief reason for deriving the single-variable equations was for comparison of alternative two-variable equations in predicting the "changing proportions" or single nutrient response curve. Seven of each of the single-variable regression equations listed below were fitted to the experimental data (namely, with (1) P_2O_5 variable and N fixed at (a) zero (b) 160 and (c) 320 pounds; (2) N variable with P_2O_5 fixed at the same levels and (3) both elements variable in constant 1:1 ratio along the northwest-southeast diagonal of Table 1).[6] To economize on space, the derived coefficients for these 35 fitted equations are not included here. However, each of the five appeared to be a "best fit"

$$Y' = m - ar^{F_1},$$
$$Y' = aF_1^{b},$$
$$Y = a - bF_1 - cF_1^{2},$$
$$Y = a - bF_1 + c\sqrt{F_1}, \text{ and}$$
$$Y = a - bF_1 + c\sqrt{F_1} - dF_1^{2},$$

[6] Hence, there were 35 equations (five algebraic forms fitted to seven sets of single-variable observations). In the equations F refers to the particular fertilizer nutrient, Y refers to yield per acre and Y' refers to yield per acre due to fertilizer.

for a particular set of the single-variable data. No one function, such as the Spillman or Douglas equation, was best for all seven regression estimates.

Five of the two-variable equations tried are shown below. Since the logarithmic or Douglas-type function causes slopes of isoyield contours to be constant along a scale line (i.e., does not allow nutrient ratios to change with higher yield levels and forces the isoclines to be linear with no convergence point at maximum yield) the observations were broken into Group A and Group B, each group representing a different portion of the data. This step was taken to allow predicted isoquants to have different slopes over different ranges of the yield surface. An overall logarithmic function also was fitted. The quadratic cross-product and quadratic square root functions allow interactions of the two nutrients in the production process, as do the logarithmic functions. In these functions Y is total yield per acres in bushels, Y′ is total yield above check plot levels, while N and P represent pounds of nitrogen and P_2O_5, respectively.

I. Logarithmic functions (Douglas-type)
   A. "Lower" observations $Y' = .401P^{.4393}N^{.3159}$
   B. "Upper" observations $Y' = 1.537P.^{1383}N^{.0770}$
   C. Pooled (overall) $Y' = .442P^{.4090}N^{.2977}$

II. Quadratic crossproduct
$$Y = 7.51 + .584N + .644P - .00158N^2 - .00180P^2 + .00081NP$$

III. Quadratic square root
$$Y = 5.682 - .316N - .417P + 6.3512\sqrt{N} + 8.5155\sqrt{P} + .3410\sqrt{NP}$$

Selection of Two-Variable Function

The statistics for the functions are given in Table 2. The coefficients of determination show the following percentages of yield variance explained by the three overall functions:[7] logarithmic (IC) 86% quadratic cross-product (II) 83% and quadratic square root (III) 91%. The t values show

TABLE 2. STATISTICS FOR THE FUNCTIONS

Function	Value of R	Value of t for coefficients in order listed in equation				
IA	.8952	11.94	9.56	xxx	xxx	xxx
IB	.3882	2.85	1.62	xxx	xxx	xxx
IC	.9255	18.62	15.23	xxx	xxx	xxx
II	.9122	9.21	10.46	5.24	8.96	10.19
III	.9582	7.91	10.44	7.32	9.81	8.85

[7] None of the statistics stated in the remainder of the text include the two interval functions (IA and IB) since there seemed to be no particular advantage of this approach.

each individual regression coefficient to be significant at the 1 percent level of probability, as are all of the R's. The multiple correlation coefficients themselves suggest that the quadratic square root function provides the "best fit" for the observations. However, since these is no direct or objective test for comparing "goodness of fit" between the three functions, numerous single-variable input-output curves were computed from each of these two-variable functions. One of these single-variable curves was computed for each row and column in Table 1 which does not have a blank cell; one was also computed for the northwest-southeast diagonal. The single-variable curves, computed from the two-variable equations, were then compared with a scatter diagram of the yield observations (from each row or column complete with the treatments as in Table 1). While none of the two-variable functions served best for each of the numerous predictions of single-variable, input-output curves, the square root function seemed the best "all around" equation for the seven single-variable relationships predicted. Next, the single-variable curves predicted from the two-variable equations were compared with the same predictions from the single-variable equations. In some instances the single-variable equations, although they are derived from fewer observations, give a better fit for estimation of a single-variable curve; they are less affected than a two-variable function, by observations from a completly different segment of the production surface. The square root two-variable function also appeared to provide the best estimates, in comparison with single-variable functions, for estimating a single-variable curve. Finally, derivation of yield isoquants and comparison of these with yield observations, in a two-way scatter diagram, suggested the square root function to be more efficient in production surface estimation than any other function examined. This particular function is used for the predictions which follow. Similar predictions have been made from other functions but, to conserve space, are not presented.

Production Surface Estimates

One set of production surface estimates is presented in Table 3. These quantities, showing the total per acre yield of corn for various rates of N and P_2O_5, are the tabular counterpart of a production surface; they represent specific points on the surface for specified points in the nutrient input plane. While not all of the treatments in every cell in Table 1 were included in the experiment, their yields can now be predicted. Each column in Table 3 is the counterpart of a vertical slice through the production surface, parallel with the P_2O_5 axis and yields correspond to points on a single-variable input-output curve. P_2O_5 is variable while nitrogen is fixed in the amount shown at the top of the column. The rows

represent the same thing with nitrogen variable and P_2O_5 fixed. It is obvious that interaction exists; the productivity of any input of one nutrient depends on the quantity of the other with which it is combined. Nitrogen, for example, has a low marginal yield, even in the range of positive marginal productivities, when no phosphate was used; P_2O_5 gives little response with no nitrogen. The first 40 pounds of one resource pushed the curve, for the other variable resource, up by more than any other 40 pound increment of the fixed nutrient. Since the soil was extremely low in both nutrients, nitrogen had a low productivity without any P_2O_5 and vice versa. Also, the level at which one nutrient is fixed, while the other is varied, must be quite high before diminishing total returns appear for the variable nutrient. With P_2O_5 fixed at the level indicated in

TABLE 3. TOTAL CALCULATED CORN YIELDS FOR SPECIFIED RATES OF APPLICATION OF NITROGEN AND P_2O_5 PREDICTED FROM SQUARE ROOT EQUATION

Pounds of P_2O_5	Pounds of Nitrogen per Acre								
	0	40	80	120	160	200	240	280	320
0	5.7	21.8	25.8	25.9	24.0	20.9	16.8	12.1	6.8
40	31.5	72.6	82.3	86.7	88.5	88.6	87.4	85.3	82.5
80	37.1	83.9	95.9	102.1	105.4	106.8	106.9	105.9	104.1
120	37.5	88.7	102.4	110.1	114.5	116.9	117.9	117.8	116.8
160	35.3	90.1	105.4	114.2	119.6	122.9	124.6	125.2	124.9
200	31.6	89.3	105.9	115.7	122.0	126.1	128.5	129.7	130.0
240	26.1	87.0	104.8	115.6	122.6	127.4	130.4	132.2	133.0
280	19.9	83.6	102.5	114.1	121.9	127.2	130.8	133.2	134.5
320	13.1	79.2	99.2	111.5	120.0	126.0	130.1	132.9	134.7

the left hand stub of Table 3, nitrogen (as the variable nutrient) shows negative marginal return for some level of input, until P_2O_5 is "fixed" at the 200 pound level. With nitrogen as the fixed resource, the input-output relationship for P_2O_5 shows diminishing returns until nitrogen is "fixed" at 280 pounds. However, as the two nutrients are varied together in a 1:1 ratio, diminishing total return (negative marginal productivity of both nutrients) is never attained. In other words, this diagonal movement from the northwest corner of Table 3 traces out a path of increasing total product, although the marginal product is declining. This relationship for constant nutrient ratios holds true whether the diagonal begins with the origin or any point along the top or left hand side of the table. While negative marginal returns are not encountered when both nutrients are increased together, this phenomenon would be encountered for heavier rates of fertilizer application. Using the derived equation to predict the maximum total yield which might be obtained, an extrapolation outside the range of observations, the point is indicated at 397.6 pounds of nitro-

gen and 336.6 of P_2O_5;[8] the maximum yield for this combination is 135.8 bushels, a quantity only slightly larger than the 134.7 in Table 2 for 320 pounds of each nutrient.

The nature of the production surface is expressed more vividly in Figure 1: The "shelf" along the axes of the input plane indicates that the productivity of any one element by itself is relatively low. The "surface

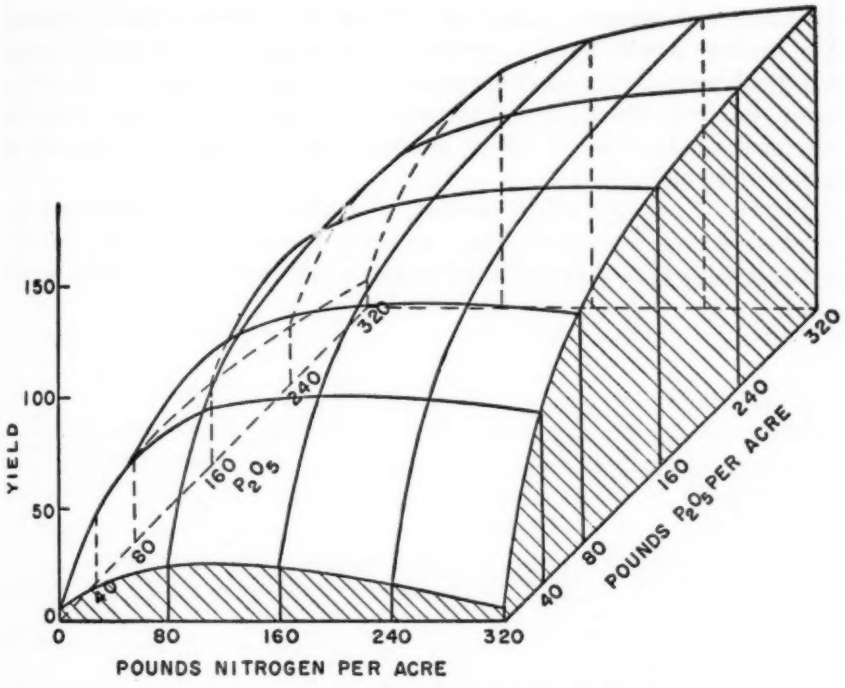

FIG. 1. PRODUCTION SURFACE FOR CORN

[8] This quantity has been predicted by setting both marginal products (the partial-derivatives) for the nutrient at zero, and solving for the quantity. The same procedure can be used in determining the maximum for any column or row of Table 3. For example, with nitrogen "fixed" at 160 pounds, we have equation 1, showing the marginal product of P_2O_5. By setting the derivative equal to zero we obtain the value of 236.2 pounds of P_2O_5 in equation 3. With P_2O_5 at 236.2 pounds, the maximum total yield is 122.6 bushels.

1. $\frac{dY}{dP} = -.417 + 4.428P^{-.5}$

2. $4.428P^{-.5} - .417 = 0$

3. $\left(\frac{6.415}{.417}\right)^2 = 236.2$

lines" running parallel to and along either the nitrogen or P_2O_5 axes have a short positive inclination. However, they "fold over," indicating diminishing total yields. This "fold over" continues far up the surface on the side of the "P_2O_5 slope" and for a considerable distance up the "nitrogen slope." It indicates again that the soil is extremely lacking in either element but that for high yields, nitrogen is more nearly a limiting resource than is phosphorous. It is entirely likely that stand level is itself a limiting resource; with planting rates heavier than those used in this experiment the surface would have a greater slope at the peak causing greater marginal productivity of either nutrient so long as moisture did not become limiting. Seed, as a variable input, helps determine both the marginal productivity of either nutrient and the profitable quantity of either nutrient.

Figures 2 and 3 further illustrate the effect of one nutrient on the productivity of the other. They are response curves for one variable nutrient with the other one fixed in the quantity indicated. (The curves

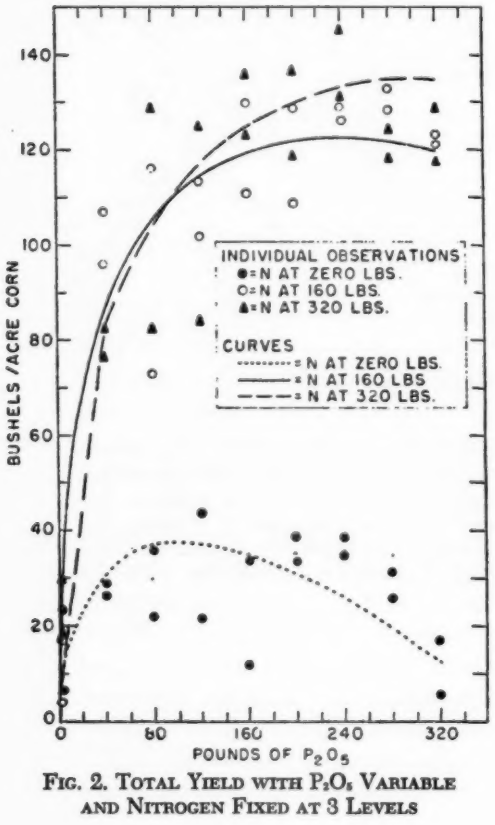

FIG. 2. TOTAL YIELD WITH P_2O_5 VARIABLE AND NITROGEN FIXED AT 3 LEVELS

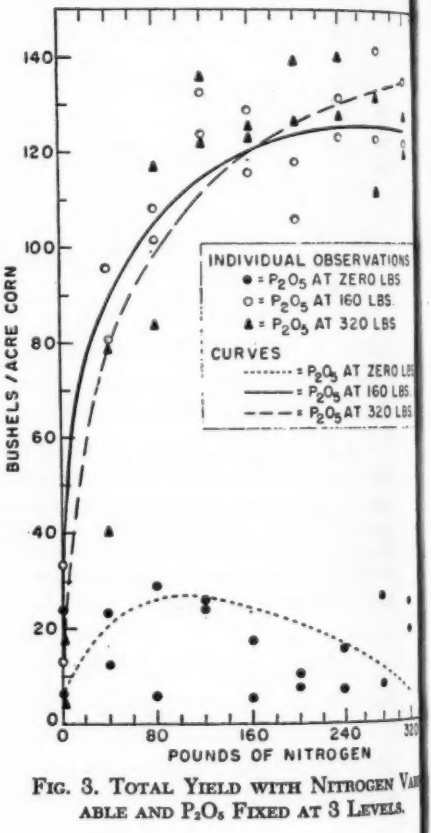

FIG. 3. TOTAL YIELD WITH NITROGEN VARIABLE AND P_2O_5 FIXED AT 3 LEVELS.

for nitrogen are the counterpart of vertical slices, perpendicular to the P_2O_5 axis, through the surface of Figure 1; the curves for phosphorous represent slices perpendicular to the nitrogen axis.) When nitrogen is fixed at zero, a declining total product is encountered with relatively small P_2O_5 inputs in Figure 2. The two curves for P_2O_5, with nitrogen fixed at 160 and 320 pounds, cross each other; for 320 pounds of nitrogen, with less than 160 pounds of P_2O_5, this element causes diminishing total returns to nitrogen; with larger amounts of P_2O_5, nitrogen is no longer excessive and 320 pounds of this nutrient interacts with larger amounts of P_2O_5 to give a greater total yield than when nitrogen is fixed at 160 pounds. Total yield does not diminish with greater P_2O_5 inputs when nitrogen is fixed at 320 pounds. A similar situation exists for the nitrogen response curves in Figure 3 for variable inputs of one nutrient, where the fixed nutrient is constant in small quantities, P_2O_5 gives a larger yield than nitrogen, indicating that the soil was relatively lower in P_2O_5 than in nitrogen (i.e., the marginal product of a pound of P_2O_5 is greater than the marginal product of a pound of nitrogen when each is combined with a zero quantity of other).

Marginal Products

The derived marginal products in Table 4 emphasize the above relationships. With input of both nutrients at 40 pounds, P_2O_5 has a marginal product of .43 bushels per pound, as compared to .36 for nitrogen. Marginal productivities are equal at .14 bushels per pound of nutrient, with 120 pounds of each; beyond this level, with nutrient inputs equal, nitrogen has a higher marginal productivity than P_2O_5.

Proportional Increase of Factors (Scale Lines)

Figure 4 represents a "scale line" type of input-output curve since both fertilizer resources are increased in a fixed 1:1 proportion in contrast to Figures 2 and 3 where proportions change. As is expected, constant returns do not exist. While it is not used for estimation purposes, the logarithmic function (IC) indicates an average elasticity over the production surface of .6967 (i.e., .4090 plus .2877); since this is less than 1.0, decreasing "returns to scale," for both resources increased together, are denoted.[9]

Products Isoquants

A relationship not previously examined in detail in agronomic or economic literature is the nature of the corn-fertilizer yield isoquant. Yield

[9] We place "scale" references in quotes since only the two nutrients are increased in equal proportions; all resources, including land, must be increased by the same proportions for true measurement of scale returns.

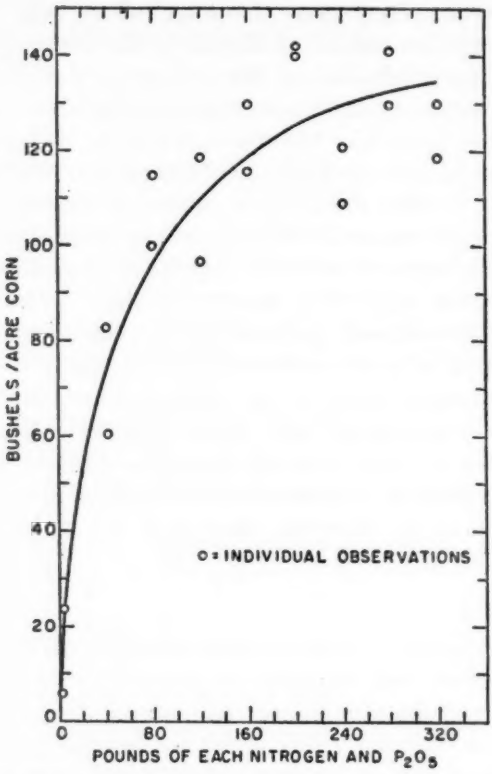

FIG. 4. TOTAL YIELDS WITH PROPORTIONAL INCREASE IN BOTH FACTORS.

isoquant equations, derived from the production function, are presented below for nitrogen and P_2O_5. Selected yield isoquants are presented in Figure 5. They indicate that as yields moved to higher levels, marginal

$$\text{IV. } N=\left[(10.05+.539\sqrt{P})\pm\sqrt{\frac{(-.4115P)+(15.0996\sqrt{P})-1.2645Y+33.153}{-.6323}}\right]^2$$

$$\text{V. } P=\left[(10.20+.408\sqrt{N})\pm\sqrt{\frac{(-.4115N)+(15.4115\sqrt{N})-1.6696Y+63.027}{-.8348}}\right]^2$$

substitution rates for the two fertilizer resources change along a "scale" line (i.e., along a straight line through the origin).[10] This change in the slopes of the isoproduct contours indicate that the two nutrients have a smaller range of "combination" ratios for higher yield levels. The two

[10] Or, the isoclines (indicating all points of equal substitution ratios on successive isoquants) are not linear but are curved. Convergence of isoclines occurs at the maximum yield per acre from fertilizer of 135.8 bushels (with 397.6 lbs. of N and 336.6 lbs. of P_2O_5).

TABLE 4. MARGINAL PRODUCTIVITIES OF NITROGEN AND P_2O_5 FOR INPUTS INDICATED. (Nitrogen at Top of Each Pair and P_2O_5 at Bottom in Italics)[a]

Pounds of P_2O_5	Pounds of Nitrogen								
	0	40	80	120	160	200	240	280	320
0	0	.19	.04	−.02	−.07	−.09	−.11	−.12	−.14
	0	0	0	0	0	0	0	0	0
40	0	.36	.16	.07	.02	−.02	−.04	−.06	−.08
	.26	.43	.49	.55	.30	.33	.35	.38	.40
80	0	.43	.21	.11	.06	.01	−.01	−.04	−.05
	.06	.17	.23	.27	.30	.33	.35	.38	.40
120	0	.48	.24	.14	.08	.04	.01	−.01	−.03
	−.03	.07	.11	.14	.17	.19	.21	.23	.25
160	0	.52	.28	.17	.11	.06	.03	.01	−.02
	−.08	.01	.04	.07	.09	.11	.13	.14	.16
200	0	.57	.31	.19	.13	.08	.04	.02	−.01
	−.11	−.04	−.01	.16	.03	.05	.07	.09	.10
240	0	.60	.33	.21	.14	.10	.06	.03	.01
	−.14	−.07	−.04	−.02	−.01	.02	.03	.04	.05
280	0	.63	.36	.23	.16	.10	.07	.04	.02
	−.16	−.10	−.07	−.05	−.03	−.02	−.01	.01	.02
320	0	.67	.37	.25	.18	.12	.09	.06	.03
	−.18	−.12	−.09	−.07	−.06	−.04	−.03	−.02	−.01

[a] Computed as derivatives from equation III in text. The derivative denotes *rate of change* in yield as related to fertilizer input. In other words, it indicates, with fertilizer at some particular level, the quantity of crop added to total yield per pound of added fertilizer, when the increase in fertilizer is by a "very small" amount (i.e., as the "change" in fertilizer input becomes infinitesimally small). With nitrogen at 200 pounds, the marginal yield (derivative) equation for P_2O_5 can be derived as follows from equation III:

$$\frac{dY}{dP} = -.417 + \frac{6.6689}{\sqrt{P}}$$

If we set P_2O_5 equal to 200 pounds, the equation becomes:

$$\frac{dY}{dP} = -.417 + \frac{6.6689}{\sqrt{200}}$$

$$= -.417 + \frac{6.6689}{14.142} = .0546$$

The .0546 means that with N and P_2O_5 both at 200 pounds, "very small" increase in P_2O_5 will add to yield at the rate of .0546 bushels for each one pound of P_2O_5. Calculations for the marginal yields of nitrogen are similar. However, the basic equation, also derived from III the text, is as follows (where P_2O_5 is first at 200 poupds):

$$\frac{dY}{dN} = -.316 + \frac{5.5868}{\sqrt{N}}$$

nutrients, while substituting over a restricted range, become limitation resources for high yields. This is indicated by the fact that the isoproduct contours approach an infinite slope on the "upper" end and a zero slope on the "lower" end. In contrast, the lower contour suggests that the 60 bushel yield quantity can be attained by a wider range of $N:P_2O_5$ ratios. For the maximum yield per acre from the two nutrients, the isoquant contour reduces to a single point indicating that it can be attained by only one combination of the two nutrients. (This predicted contour of a single point occurs at 135.8 bushels with 397.6 pounds of N and 336.6 pounds of P_2O_5.) Diminishing returns to one nutrient by itself or both nutrients together also is illustrated in Figure 5; a line perpendicular to the vertical

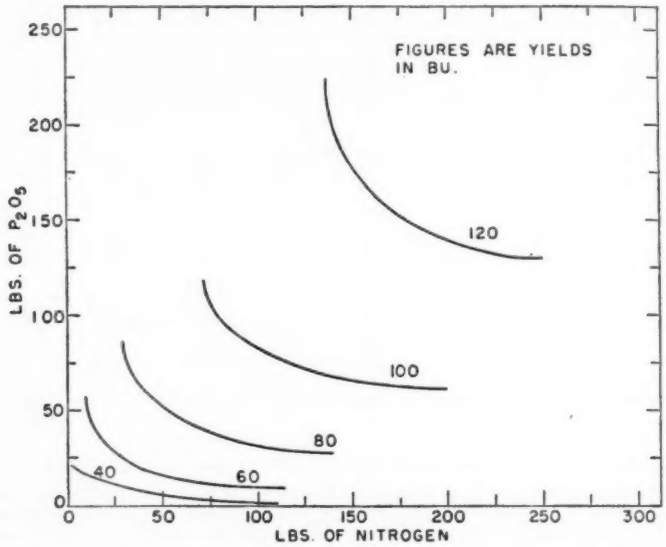

FIG. 5. YIELD ISOQUANTS SHOWING ALL POSSIBLE NUTRIENT COMBINATIONS IN PRODUCING SPECIFIED YIELD. (ENDS OF CURVES GIVE LIMITS IN NUTRIENT SUBSTITUTION.)

axis (denoting varying proportions of P_2O_5), one perpendicular to the horizontal axis (denoting varying proportions of nitrogen) or a diagonal one through the origin (denoting both resources increased by the same proportions) has segments of increasing magnitude between points of intersection by the yield isoquants. This phenomena defines diminishing marginal productivity; larger and larger increments of nutrients are necessary to obtain equal increments in yield.

The change in the slopes of the yield isoquants (along a "scale line") suggests that the combination of the two nutrients which will give the lowest cost, for a stated yield, changes with the level of yield: the nutrient

combination which is optimum for a 100 bushel yield is not also optimum for a 50 bushel yield. This point also is illustrated with the isoquant and substitution data of Table 5. The least-cost resource combination for a given yield is attained when the marginal rate of substitution of the resources is equal to the inverse price ratio. Hence, we can illustrate that proportion of the two nutrients, to give the least cost, differs with yield level. First, we derive the equations of marginal rates of substitution as in VI and VII below. Second, we set these equal to the particular price

Table 5. Fertilizer Combinations and Corresponding Marginal Rates of Nutrient Substitution (P_2O_5 for N) for Yields of 60 and 120 Bushels

Pounds N	60 Bu. Yield Pounds P_2O_5	Marginal rate of substitution P_2O_5 for N[a]	Pounds N	120 Bu. Yield Pounds P_2O_5	Marginal rate of substitution P_2O_5 for N
150	9.6	118.9			
160	9.7	71.13			
170	9.9	52.25			
180	10.1	42.01			
190	10.4	35.61			
200	10.7	31.12			
210	11.0	27.80			
220	11.4	25.21			
230	11.8	23.13			
240	12.2	21.40			
250	12.7	19.94			
260	13.2	18.69			
270	13.8	17.59	270	129.8	43.45
280	14.4	16.62	280	130.2	20.38
290	15.0	15.76	290	130.8	13.78
300	15.7	14.98	300	131.6	10.63
310	16.3	14.27	310	132.7	8.79
320	17.1	13.63	320	133.9	7.56

[a] Pounds N replaced by one pound P_2O_5 at each of the fertilizer combinations listed. Computed from equations defining marginal rates of substitution. The range of combinations included are those within which the nutrients are predicted to be replaceable (i.e., the range of negative marginal rates of substitution).

A marginal substitution ratio is similar to a marginal yield ratio in Table 4. It shows the amount of one nutrient replaced by an infinitesimally small increase in the other with the nutrients combined in the quantities specified in the first two columns. Lack of space prevents illustration of its derivation. However, the procedure is exactly the same as for the marginal yields of Table 4. The only difference is this: the derivatives are now those for equations IV and V defining yield isoquants. If we take the derivatives of these equations and plug in the quantities of nutrients, we can compute the substitution rate for any *small change away from* this combination. The equations defining marginal substitution rates are denoted as VI and VII in the text. By substituting in two values, such as 240 lbs. of N and 12.2 lbs of P_2O_5, we obtain the substitution ratio, such as 21.4 for this combination.

$$\text{VI.} \qquad \frac{dN}{dP} = \frac{-.8348\sqrt{PN} + 8.5155\sqrt{N} + .3410N}{-.6323\sqrt{PN} + 6.3512\sqrt{P} + .3410P}$$

$$\text{VII.} \qquad \frac{dP}{dN} = \frac{-.6323\sqrt{PN} + 6.3512\sqrt{P} + .3410P}{-.8348\sqrt{PN} + 8.5155\sqrt{N} + .3410N}$$

ratio for the nutrients and solve for the nutrient combination which minimizes cost for the particular yield.

Using these procedures, we obtain the nutrient combinations in Table 6; these are the least-cost combinations for the specified price ratios and yield isoquants. With an N/P price ratio of 1.5, the combination for a 50 bushel yield should total 36.1 pounds; 32.7 percent of this should be nitrogen and 67.3 percent should be P_2O_5. For the same price ratio, a total of 180.9 pounds, composed 43.8 percent nitrogen and 56.2 percent P_2O_5 should be used to minimize fertilizer cost for a 100 bushel yield. The mixture, to minimize cost for a given yield, should contain relatively more nitrogen for higher yield levels. Traditionally, this distinction has not been made in fertilizer recommendations; the same fertilizer mix has,

TABLE 6. COMBINATIONS OF NITROGEN AND P_2O_5 TO MINIMIZE FERTILIZER COSTS PER SPECIFIED YIELD LEVEL FOR DIFFERENT PRICE RATIOS

Yield Level	Optimum lbs. of N	Optimum lbs. of P
	Price of .18 per lb. for N and .12 per lb. for P ($\frac{N}{P}$ ratio of 1.5)	
50 bu.	11.8	24.3
100 bu.	79.3	101.6
	Price of .12 per lb. for N and .18 per lb. for P ($\frac{N}{P}$ ratio of .67)	
50 bu.	19.8	16.3
100 bu.	99.1	82.7

for a given soil and productivity situation, usually been recommended for numerous yield levels. Similarly, with a change in the price ratio from 1.5 to .67, the percentage of nitrogen, for a 50 bushel yield. For a 100 bushel yield, similar changes in the price ratio should cause the nutrient combination to change from 43.8 percent to 54.5 percent nitrogen.

Profit Maximization

The goal in deriving two variable functions is to make more efficient recommendations in the economic use of fertilizer. Simple mechanical procedures can be used for making the recommendations. They are not presented here because of space limitations.[11] One simple procedure is that of "successive approximation." It can be used in Table 4 to find the best level of applying any one nutrient. With nitrogen fixed at 40 pounds we can move down the column and find the maximum quantity of P_2O_5

[11] For example, see Heady, Earl O. et al. "Productivity and Substitution Coefficients in Pork Output," *This Journal* Vol. 35. Procedures such as this one while somewhat different in makeup can be constructed to simplify the use of our "apparent complex" data.

which is profitable. With corn selling at \$1.40 per bushel and P_2O_5 at 12 cents per pound, the P_2O_5 corn price ratio is $\frac{.12}{1.40}$ or .086. Hence, the 80th pound of P_2O_5 is profitable because its marginal product of .17 is greater than the price ratio; the 120th pound of P_2O_5 is not profitable because its marginal product of .07 is less than the price ratio. The optimum quantity of P_2O_5 is actually 118.2 pounds.[12] If nitrogen has a price of 20 cents per pound the N/corn price ratio is $\frac{.20}{1.40}$ or .14. Starting from 80 pounds of P_2O_5 and 40 of nitrogen and moving right in the row (P_2O_5 now fixed at 80 pounds), the 80th pound of nitrogen is profitable because its marginal product is .21; the 120th pound is not since its marginal product of .11 is less than the price ratio. Starting from 80 of P_2O_5 and 80 of nitrogen and moving down the column, the 120th pound of P_2O_5 is now profitable since its marginal product of .11 is greater than the price ratio of .986.

Simultaneous Solution

Rather than go through the successive approximation processes outlined above, we can simultaneously solve (1) the combination of nutrients to give least cost for the particular yield and (2) the amount of the two nutrients to apply to maximize profit. These optima are attained when the partial derivatives (the marginal products) for both nutrients are equal to the $\frac{\text{nutrient}}{\text{corn}}$ price ratio. Hence with a price of \$1.40 for corn, .18 for nitrogen and .12 for P_2O_5, the equations become IX and X below:

$$\text{IX.} \qquad \frac{\partial C}{\partial N} = -.316 + \frac{3.1756}{\sqrt{N}} + \frac{.1705\sqrt{P}}{\sqrt{N}} = \frac{.18}{1.40}$$

$$\text{X.} \qquad \frac{\partial C}{\partial P} = -.417 + \frac{4.2578}{\sqrt{P}} + \frac{.1705\sqrt{N}}{\sqrt{P}} = \frac{.12}{1.40}$$

[12] With a P_2O_5/corn price ratio of .086, the optimum application of P_2O_5 with N at 40 pounds, can be determined exactly by setting the partial derivative for P_2O_5 at .086 and solving for the quantity. Hence we have equations (1), (2) and (3) below specifying 118.2 pounds of P_2O_5 for maximum profit.

(1) $.086 = -.417 + 5.359P - .5$

(2) $P = \frac{(5.359)^2}{(.493)}$

(3) $P = 118.2$

From simultaneous solution of these equations, we obtain the figures for situation A in Table 7: 298.93 pounds of fertilizer should be used, including 156.45 pounds of P_2O_5 and 142.48 pounds of nitrogen.

The same procedure has been used for the other price situations in Table 7. With a decline in corn price by 36 percent (from situation A to situation B), total usage of fertilizer should decline by 30 percent. Input of nitrogen should decline 34 percent and input of P_2O_5 should decline 26 percent, if profit is to be at a maximum; inputs should not be reduced by the same proportions. With a 43 percent increase in corn price (from situation A to situation C), total input of fertilizer should increase by 25 percent; input of nitrogen should increase by 30 percent and input of

TABLE 7. OPTIMUM QUANTITY OF FERTILIZER AND OPTIMUM COMBINATION OF NUTRIENTS FOR SPECIFIC PRICE RELATIONSHIPS.[a]

Price situation	Optimum Yield (bu.)	Optimum fertilizer use		
		Total Pounds	Pounds N	Pounds P_2O_5
A: corn at $1.40; N at .18; P_2O_5 at .12	117.21	298.93	142.48	156.45
B: corn at $ .90; N at .18; P_2O_5 at .12	104.99	209.27	94.06	115.21
C: corn at $2.00; N at .18; P_2O_5 at .12	124.22	374.84	185.04	189.80
D: corn at $2.00; N at .12; P_2O_5 at .12	122.30	349.50	180.19	169.31
E: corn at $2.00; N at .12; P_2O_5 at .18	124.91	384.18	208.72	175.46

[a] These quantities were solved from equations IX and X in the text. These computations are similar to those for Tables 4 and 5. What we have done is find the marginal yield ratio which is equal to the particular price ratio; it defines the most profitable level of fertilizer use. After finding this marginal yield ratio, we have determined, from the equations the quantity of P_2O_5 and N consistent with it.

P_2O_5 should increase by only 21 percent. With corn at $2.00 and a 1:1 price ratio for nutrients (situation D), input of nitrogen should be greater than input of P_2O_5. With a P/N price ratio of 1.5 (situation C) input of phosphate should be about 5 pounds greater than input of nitrogen. However, with a P/N price ratio of 1.5 (situation E) input of nitrogen should exceed input of phosphate by 33 pounds.

It has been illustrated that simultaneous solution of (1) the optimum rate of fertilization and (2) the optimum combination of nutrients, is possible from appropriate experimental data. Also, illustrated were some points ordinarily overlooked in both economic and agronomic recommendations; a reduction in product price not only may call for a reduction in the total quantity of fertilizer used; it also may specify a change in the fertilizer grade or ratio. These and many other basic principles can be applied when fertilizer experiments are designed to provide relevant marginal quantities and the corresponding economic analysis.

ECONOMIC RATING OF SOILS FOR TAX ASSESSMENT

ANDREW R. AANDAHL, WILLIAM G. MURRAY AND WAYNE SCHOLTES*

RESEARCH in tax assessment of farm lands has indicated striking inequalities.[1] Since new information on soils, plant growth, and economics—needed in tax assessment—has become available in recent years, it is possible to take a new look at these inequalities. The authors believe that an excellent opportunity exists to use this new information for the improvement of tax assessments.

Such an opportunity to improve assessments was provided by the Assessor of Allamakee County, Iowa, A. L. Hansmeier,[2] who asked for assistance from the Iowa Agricultural Experiment Station in using the new county soil survey in the reassessment he was making of the county. As a result, the method described in this article, including economic classification and ratings, was designed by the authors and used by the assessor in the reassessment. The authors believe that the principles on which this method is based have general application and that a decided improvement in assessments can be obtained through their use.

The authors do not intend this article to be a comprehensive discussion of the entire problem of land valuation for tax assessment. Rather it is primarily a description of a method of using soil maps to estimate the economic productivity of land holding constant management and location. The method results in a first approximation of the assessed value which must be adjusted for the location and building aspects.

The Soil Map

During the past fifty years, the soil scientists of the United States have developed a system of soil classification which is very useful in solving many agricultural problems. The permissible range of soil characteristics within a soil type or phase is now sufficiently narrowed in most instances to make rather precise predictions. Estimates of crop yields for a soil type or phase under defined set of soil management practices are now fairly accurate. Part of this increased accuracy is the result of better analysis of crop yield data which is now possible with the improved soil

* Soil Scientist, Soil Conservation Service, Professor of Economics, Iowa State College; Associate Professor of Soils, Iowa State College, respectively.

[1] William G. Murray, "New Developments in Farm Appraisal for Loans and Tax Assessment," *This Journal*, Vol. XXXIII, No. 4, November 1951, pp. 857-865. William G. Murray, "Improvement in Real Estate Taxation Through Assessment-Sales Studies." *National Tax Journal*, Vol. V, No. 1, March 1952, pp. 86-92.

[2] The authors owe much to A. L. Hansmeier for his interest and whole-hearted cooperation.

classification. Also, more and better sources of crop yield data exist. Principles of plant growth under different soil conditions are better understood. More and more economists and others are utilizing these predictions of the physical scientist and applying them to problems of farm management and land economics.

The accuracy of soil mapping has improved concurrently with the development of the present soil classification. A large part of this increased accuracy is the result of using aerial photographs as the base map on which the soil separations are made in the field. The aerial photographs permit the soil surveyor to concentrate all his attention in the field to studying the soils. Prior to the use of photographs, much of the surveyor's effort was expended in the constructing of the base map and in keeping himself located on it. Also, the acceptable standards of soil mapping have greatly increased, and today the soil surveyors must spend more time examining a given area even with aerial photographs than was required 25 or 30 years ago. In order to show the greater amount of soil detail now considered necessary, the scale for field mapping has been increased in most areas from the old standard of 1 inch per mile to 4 or 8 inches per mile. The scale and detail required depend partly upon the agriculture of the area and partly upon the soil pattern. Range land and dryland farming areas in general require less detail than those in the more humid areas.

County assessors and others charged with the duty of tax assessment are becoming more appreciative of soil maps. Because they often want to use the maps before they are ready for publication, and because they prefer the larger scale and the background of the aerial photograph, county assessors often obtain copies of the field sheets. They usually pay for these reproductions. If the soil mapping was originally done on a scale of 4 inches per mile, the reproductions are often enlarged to 8 inches per mile to facilitate measurement of the different soil areas. The aerial photographic base shows many physical features not included in the soil map. These physical features are very useful in locating specific tracts and in determining the most feasible land use of each area.

The extent to which soil maps can be used for assessing land depends upon both the detail and the quality of the classification and of the mapping. If these are adequate, a first approximation of the value of any specific tract of land can be made directly from the maps. It needs to be adjusted for other factors, particularly those related to location, such as schools and roads, With refinements and adjustments by soil specialists, some old maps could be used with considerable confidence. Others might be useful only for comparing large areas and for establishing general relationships.

Some physical predictions cannot be made from the soil map without additional information. For example, the flood hazard of soils in the

bottomlands varies from area to area of the same soil. The degree of flood hazard cannot be interpreted from the soil map but must be obtained from observations of the flooding and its damage over a long period. Hansmeier made the evaluation of the flood hazard based on his own observations and those of others in the County. His evaluations were used in this study.

General Procedure for Using Soil Maps in Tax Assessments

Soil maps have been used in many areas for assessment of farm lands[3] and the methods followed have many similarities. The approach is generally as follows:

1. Economic ratings are prepared for each mapping unit or combinations of similar units shown on the soil maps.
2. If ratings are prepared for more than one land use, the land is classified into the different uses such as pasture and cropland.
3. For each tract assessed separately, the acres of each combination of soil mapping unit and land use are measured and recorded.
4. Using these acreages as weights, an average rating for each tract is calculated.
5. Average ratings for individual tracts are converted to assessed dollar values by multiplying by some constant.
6. The assessed dollar values are adjusted for the other factors not included in the rating.

Much of the variation in the procedure used by different people is in the nature and preparation of the economic ratings. Many of these ratings are direct judgment estimates made without any intermediate estimates. The economic ratings for Allamakee County were prepared by making the intermediate estimates and using these in the calculation of the ratings.

Preparation of the Economic Ratings

Farmland is used principally for crops, permanent pasture or timber, and the returns to the farmer from the same kind of soil varies depending upon which use is most feasible. Some cleared areas of a soil well suited for cropland are so isolated and small that production costs are increased

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[3] Charles E. Kellogg, "A Method for the Classification of Rural Lands for Assessment in Western North Dakota," *Journal of Land and Public Utility Economics*, February 1933.

W. H. Scholtes, and F. F. Riecken, "Use of Soil Survey Information for Tax Assessment in Taylor County, Iowa," *Soil Science Society of America Proceedings*, Vol. 16, No. 3, July 1952, pp. 270-273.

Andrew R. Aandahl, "Using Soil Survey Information in Land Valuation for Tax Assessment," *Soil Science Society of America Proceedings*, Vol. 17, No. 3, July 1953, pp. 293-294.

to the extent that more returns can be obtained from pasture. Such areas require a pasture rating. Also areas with scattered trees require a pasture rating. Timber tracts in Allamakee County, where the trees are too dense for grass to grow, were rated on the basis of timber produced annually because the cost of clearing is almost prohibitive at the present time. Thus, more than one economic rating is needed for each soil.

The land is usually classified by the assessor according to its highest and best use—the use with the highest net income. It does not refer to the soil management practices within any one use. The reason that areas of the same kind of soil may be classed differently is that input costs are influenced by the other soils associated with it. For example, a small area of an excellent soil for growing crops may be isolated and surrounded by stony land. Under such conditions, the increased production costs can make it more profitable to use the land for pasture. Present use by itself is not sufficient reason for basing the assessment on that use.

The general approach used in preparing the cropland economic rating is very similar to that used in farm appraisal. For each soil, the net income is estimated on the basis of the most likely physical production and costs. The highest net income is given a rating of 100 percent and the net income of the other soils compared with it. The net income from the annual production of timber is also compared with the highest net income from crops, and the result is the timber rating. The pasture rating is obtained by a different approach but it is tied directly to the economic rating for crops.

Economic Rating for Crops

The economic rating for crops was prepared in the following steps:

1. Estimation of physical production.
   a. Estimation of "most likely" or average soil management for each soil used for crops.
   b. Predictions of the average yield for each crop on the basis of the above sets of soil management practices.
2. Conversion of physical production into net income.
   a. Prediction of future prices and calculation of gross income.
   b. Estimation of cropping expenses and calculation of net income.
3. Conversion of net income into percentage rating.

The estimation of the average or most likely set of soil management practices must be completed before the yield estimates can be made because they involve considerations of the soil and its management. Furthermore, it must be realized that average soil management is not the same for all soils; it is different for most soils. Average soil management must be estimated for each soil.

The description of the soil management estimated for each soil should be as complete as possible, including such things as the percentage of the different crops grown, the crop sequence, applications of fertilizers and erosion-control measures. The yield estimates should be based upon all the data available on crop yields on the soils in question and on the established prinicples of plant growth in relation to soil conditions. Much information of crop yield is being obtained from cooperative studies by economics and soils departments. The soil and plant scientists have a bigger responsibility for obtaining such crop yield data than they have recognized in the past.

Net income for each soil mapping unit devoted to growing crops is estimated by multiplying the physical returns by the predicted prices, and subtracting the estimated costs of production based on custom rates. What prices to use is obviously a question on which there may be wide disagreement. But this is a usual difficulty because no value or assessment system can avoid the choice of a price level. Once the level has been decided, the appropriate crop price in conformity with this level is applied to all of the land producing this crop in the county or area.

Similarly, there may be disagreement on the custom rates to be used. But once the rates are selected, the significant factor is the application of appropriate rates in line with the overall rates to all of the land in the assessment area. An alternative to the use of custom rates is the rental or landlord share system. Both systems were tried, but for Iowa conditions the custom basis appeared to give more precise results largely because the rental method has in it so much tradition that it does not give a good differentiation between soils of varying productivity.

Various methods may be used in preparing economic ratings but the one which appears most desirable is the designation of the soil with the highest net income as 100 percent, or a rating of 100. If this soil gives a net income expectation of $20 an acre, then a soil yielding a net income of $15 an acre would have an economic rating of 75. If, later, a soil is found which is estimated to yield more than $20, say $25 an acre, then its rating would be above 100. In this case it would be 125. This may happen where soil maps and economic ratings are used for land assessment before the soil survey is complete. A soil, on the other hand, which yielded no net income would have an economic rating of 0.

Economic Rating for Permanent Pasture

Since pasture does not have the same gross income-cost relationship as cropland, a different procedure is required for permanent pasture. The steps in preparing the economic rating of permanent pasture are as follows:

1. Estimation of the relative grass production of each soil mapping unit in such terms as cow-days per acre.
2. Estimation of the ratio between the economic rating for crops and the cow-days per acre at the "Balance Point."
3. Conversion of cow-days per acre into economic ratings by use of the "Balance Point" ratio.

One method of expressing pasture-yield estimates is by number of days a cow can be pastured on an acre during a season. For example, the yield of a pasture which will carry a cow to the acre for the season of six months would be 180 cow-days per acre. If the pasture was such that it took two acres to support a cow for the same period, then the physical pasture rating would be 90. This method is closely in line with actual practice since it is common to speak of a pasture carrying so many head of cows for the season. However, other methods of expressing pasture production would not alter the basic approach.

Crop and pasture economic ratings can be tied together by noting the kinds of soil on which the farmer finds it difficult to decide whether to put the land into crop or into pasture. The net returns from these soils according to the farmer's best judgment are equal for both uses. One farmer would say the land should be left in pasture while another farmer would regard the land as marginal for crop purposes. These soils are at or near what we will call the "Balance Point" (see Figure 3). In observing which soils are at or near the "Balance Point," only large tracts are considered. The land use of small tracts are dependent upon the associated soil. Also, areas adjacent to the farmstead are not considered because their use is too closely related to the livestock program of the farm.

The next step is to calculate the ratio between the crop economic rating for these soils at this "Balance Point" with the number of cow-days per acre. This ratio then provides a conversion factor for use on other soils where the comparison between cropland and pasture would be more difficult. The basis for this procedure is the observed tendency of net and gross pasture returns to maintain a constant relationship regardless of the pasture yields. In other words, farmers are willing to pay for pasture in direct proportion to its productivity, paying twice as much for a 100 cow-days-per-acre pasture as a 50 cow-days-per-acre pasture. On the other hand, as the productivity of cropland declines the net return declines even more rapidly and reaches a zero point long before the yield reaches zero. From the cost side, crop costs increase as physical yields increase but at a slower rate than gross income (see Figure 1). In some instances they may decrease. Pasture costs, as pointed out above, vary at nearly the same rate as physical yield and gross returns (see Figure 2).

The significant difference between pasture and cropland costs is that

pasture costs are figured on a livestock herd basis whereas crop costs are figured on an acre basis. Harvesting a pasture during a season requires the management of a livestock herd, the cost of which will be roughly the same whether good or poor pasture is used. Making a crop, on the other hand, requires operations like plowing, planting and the like, which are not related to productivity but are related directly to the size of the area. The important exception to this is harvesting expenses which do vary with yield.

The net income from crops and pasture, shown in Figures 1 and 2, are

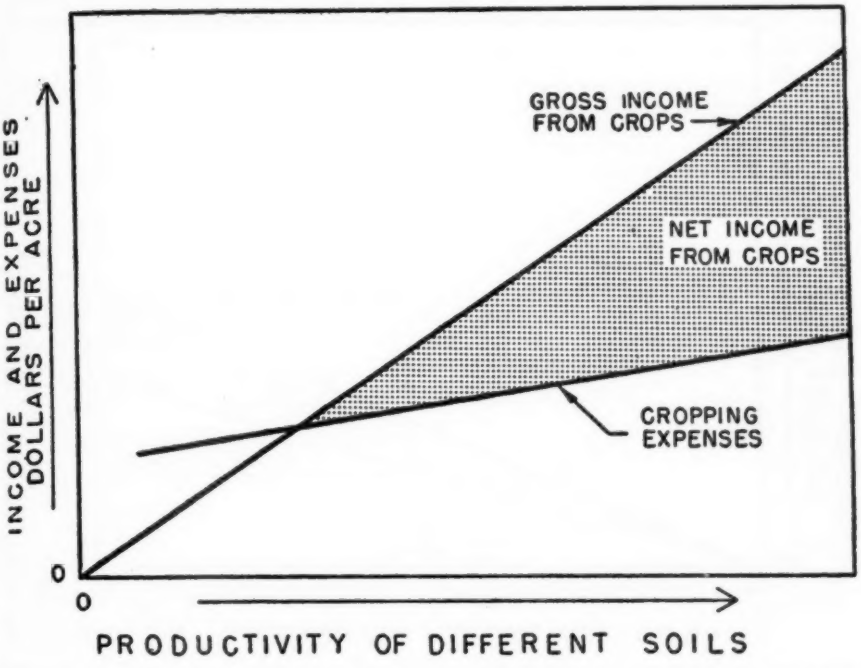

FIGURE 1. THE GENERAL RELATIONSHIP OF GROSS INCOME, EXPENSES, AND NET INCOME FROM CROPS ON SOILS OF DIFFERENT PRODUCTIVITY.

shown together in Figure 3. They cross over at the point indicated in Figure 3 as the "Balance Point". *This point is the key to the relationship between the pasture rating and the crop rating.* Here the two ratings are the same. Farmers, in their judgment, can make as much money on soils of this productivity when they are used for pasture as when they are used for crops.

Once the ratio between carrying capacity (cow-days per acre) and the economic rating for crops has been calculated for the soil at the "Balance Point," the pasture rating for other soils is obtained by multiplying the

cow-days per acre by this ratio. If the ratio at the "Balance Point" is .30, that is, the economic rating is 30 percent of the number of cow-days per acre, then this same ratio would be used in calculating pasture ratings of soils not at the "Balance Point". A pasture with a physical yield estimated at 90 cow-days per acre would have an economic rating of 27.

Economic Rating for Timber

Economic ratings for timber have to be prepared on a different basis than those for either crop or permanent pasture. The general procedure,

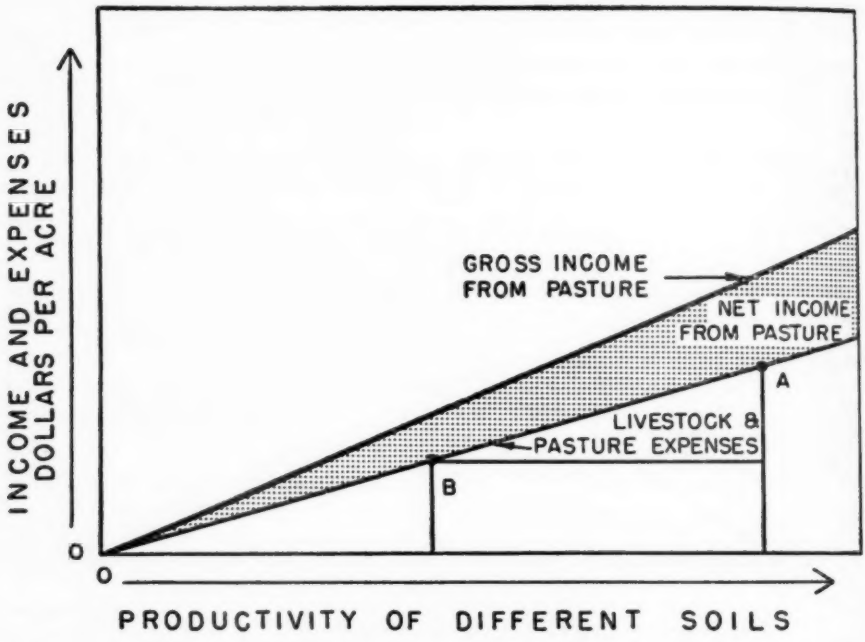

FIGURE 2. THE GENERAL RELATIONSHIP OF GROSS INCOME, EXPENSES, AND NET INCOME FROM PERMANENT PASTURE ON SOILS OF DIFFERENT PRODUCTIVITY.

however, is roughly the same as that for crops; namely, estimation of physical yield, selecting a price, and conversion to an economic rating. In the case of timber, the first step is an estimation of the annual timber production by whatever method is applicable in the area. Second, this annual production can be converted into net income by use of a stumpage prize. Finally, the timber net income per acre is related to the highest net income per acre for crops to obtain the economic rating for timber.

The stumpage price involves no costs to the farmer, and therefore, the gross income and net income are the same. For areas where the timber

market is well established on a different basis, a modified method would be needed.

The Method Illustrated

In the following illustration, the method outlined above is applied to Allamakee County, Iowa, where the County Assessor, A. L. Hansmeier, used the method in a reassessment of farm land in the county.

A soil survey of Allamakee County was recently completed. Copies of the field sheet enlarged to 8 inches equal to 1 mile were used. Since assessment of farm land in Iowa is required on tracts of 40 acres, the copies of the field

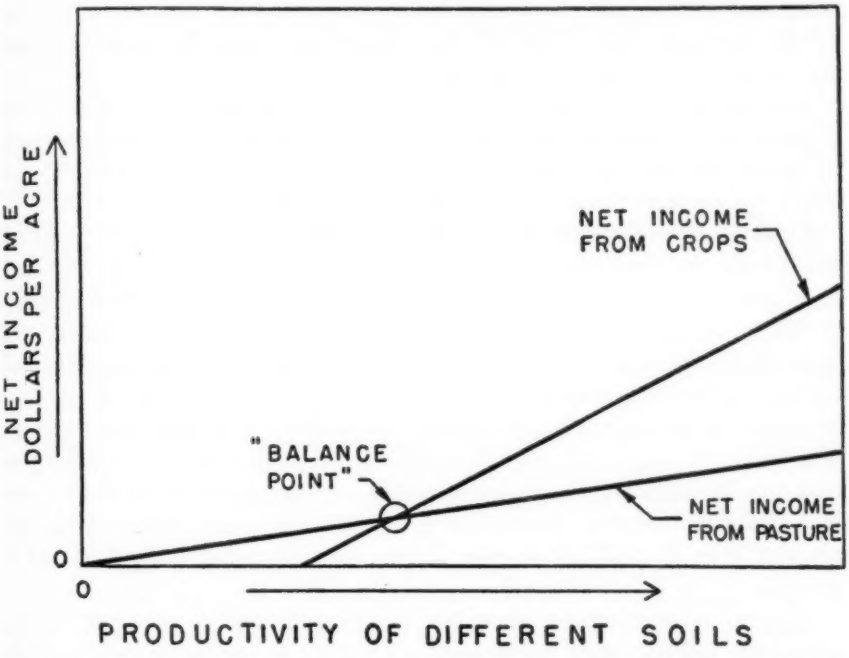

FIGURE 3. THE GENERAL RELATIONSHIP OF NET INCOME FROM CROPS AND FROM PERMANENT PASTURE ILLUSTRATING THE "BALANCE POINT."

sheets were divided into 40 acre units for the reassessment. Hansmeier has in his files a card for each tract on which is glued the photographic copy of the soil map and on which all measurements and calculations are recorded.

Cropland

The percent of the rotated acres and the yield of each crop grown were estimated separately for each of the 39 soil mapping units. These 39 included 23 different soil types and land types, of which 10 had one or more

subdivisions or phases. An example of the physical production estimates for Fayette silt loam (4-7% slope) follows:

Crop	Crop Proportions	Crop Yield
Corn	34 percent	54 bushels per acre
Oats	33 percent	36 bushels per acre
Hay	33 percent	1 ton per acre

In addition to the crop proportions indicated, the other aspects of the estimated most likely set of soil management practices are adequate use of lime, application of considerable manure but very little commercial fertilizer and limited use of terracing, contouring or strip cropping. These estimates were based on Annual Farm Census data by townships, records of the Northeast Iowa Farm Business Association, and the opinions of soil survey personnel, farmers, and other agricultural workers.

Net income was obtained by converting the physical production into gross income and subtracting the expenses. Estimates of future prices used to obtain the gross income were \$.95 a bushel for corn, \$.55 for oats, and \$10 a ton for hay. Gross income per acre for the same soil was \$27.28.

Expenses were figured on a custom rate basis.[4] Without going into all the details, the total custom charges for growing an acre of corn amounted to \$13.60 an acre, the principal items making up this total were plowing at \$2.50, cultivating at \$3.00 and corn picking at \$3.60. Growing and harvesting oats plus clover and timothy seed costs were \$12 an acre, and harvesting the hay crop were \$4.60 an acre plus \$5.50 per ton for baling, hauling and storing. A charge of \$.10 per bushel for storage and handling was made for corn and oats. In addition to the direct costs, a charge of \$.75 an acre was made for lime and fertilizer. The expenses for the Fayette soil described above amounted to \$15.69 an acre. Subtracting this amount from the \$27.28 of gross income we get a net income of \$11.59 an acre.

Conversion of the net income into economic ratings is accomplished by giving the soil unit with the highest net income an economic rating of 100. For Allamakee County this was Tama silt loam, slope 1 to 4 percent, and Judson silt loam, slope 1 to 6 percent, with a net income per acre of \$20.46. These soils were given ratings of 100. Fayette silt loam, slope 4 to 7 percent, with a net income of \$11.59 per acre, is only 57 percent of the Tama and Judson, which gives this soil an economic rating of 57.

Economic ratings for cropland were prepared for 22 out of the 39 soil units mapped, the other 17 units being suitable only for pasture or timber.

[4] This method of estimating expenses permits a further refinement—not considered here—which would include a consideration of production cost differences of soils. The charges per acre for the operations may be varied and also the number of operations. For example, it costs more per operation on steep land than on level land, and more operations are required to prepare an adequate seed bed on some soils than on others.

Permanent Pasture

In Allamakee County, three soils represent the condition very near the "Balance Point." They are listed below with their crop economic ratings and cow-days-per-acre estimates.

	Crop Economic Rating	Cow-days per Acre	Ratio
Dodgeville silt loam (10-16%)	28	90	.31
Dubuque silt loam (10-16%)	14	60	.23
Quandahl silt loam (13-16%)	20	70	.29
		Average Ratio	.28

To get the pasture ratings for all of the soils, the cow-days-per-acre estimates were multiplied by .28. For example, the Fayette silt loam which had a crop rating of 57 was estimated to have a pasture yield of 100 cow-days per acre, which gives a pasture rating of 28. In this case it is obvious that with a crop return twice that likely to be received from pasture, Fayette silt loam (4-7% slope) would not be used for permanent pasture in most instances. Quandahl silt loam (17.24% slope) on the other hand, has an estimated cow-days per acre of 50 which gives a pasture rating of 14. This soil with a crop rating of 7 and a pasture rating of 14 would likely be used for pasture. Actually, most of the areas of this soil are being used for pasture or timber.

Woodland

The timber in Allamakee County was estimated on the basis of predominant oak stands. Fortunately, site indexes for many of the soils in the County are available.[5] The site index was used to figure the volume of board feet. The volume was multiplied by the estimated average percent stand, 70, divided by the age and multiplied by the stumpage price of $15 a thousand board feet.

For the Fayette soil in Allamakee County, the site index was 60, the volume 15,650 board feet, the stand assumed to be 70 percent. With an age of 80 years, the annual production of timber is 137 board feet. The net income at $15 a thousand comes to $2.05 an acre. This net income of $2.05 compared to the $20.46 for the crop rating of 100 gives a timber rating of 10 for the Fayette soil.

The general relationship between the different uses can be noted in Table 1. These soils represent the range of conditions in Allamakee County. On the more productive soils, the spread between the crop, pasture and timber ratings is great; on the less productive soils, the spread narrows. At the "Balance Point" the crop and pasture ratings are the same. Below the "Balance Point" the crop rating was not used, but a justification for using a crop rating lower than the pasture rating can be made for some

[5] Dean William Einspahr. 1950, "Site Index of Oak in Relation to Soil and Topography." Iowa State College Master's Thesis.

soils under some situations. For example, the value of small areas of a very unproductive soil in fields of very productive soils for cropland would be less than areas of the same soil in pastures. In fact, it is possible for some soils under such circumstances to have a negative value. However, such refinements were not considered justifiable in Allamakee County.

How the Classification Should Be Used in the Assessment of Farm Land

The final assessed value placed on each tract of land by a county assessor represents his best judgment. In the end it is his decision. The soil maps and the economic ratings merely help the assessor to improve his opinion of the value. The procedure outlined here should not be considered as an infallible mechanical process, but rather as one which provides the assessor with a first approximation of the value or an estimate of the earning capacity of the land. The approximation will require adjustments for other factors affecting value of land.

TABLE 1. ECONOMIC RATINGS FOR CROPS, PASTURE AND TIMBER FOR 7 SOILS IN ALLAMAKEE COUNTY, IOWA

Soil	Slope	Economic Rating Crop	Pasture	Timber
	%			
Judson	1–6	100	39	—
Downs-Tama	4–7	77	36	10
Fayette	4–7	57	28	10
Fayette	8–14	42	22	10
Quandahl	13–16	20	20	9
Stony land	18–30	—	11	5
Stony land	30–60	—	1	1

The calculation of the economic rating for each taxable tract of land includes the following steps with an example:

A. Determine the most feasible land use—crop, pasture or timber—for each delineated area of each tract.

B. Measure the acreage of each combination of soil mapping units and land use which require a different rating.

C. Add the products of each combination multiplied by its rating and divide the sum by total number of acres in the tract.

Soil Map Symbol and Use		Acres	Rating	Product
161-7-1	(Crop)	5	57	285
163-7-1	(Pasture)	4	28	112
163-7-1	(Timber)	6	10	60
183-12-2	(Crop or pasture)	3	16	48
183-12-2	(Timber)	7	8	56
378-25-0	(Pasture)	2	11	22
378-25-0	(Timber)	9	5	45
478-50-0		4	1	4
	Total	40		632

Average Relative Economic Rating for Tract 16

The determination of the most feasible use of each area requires a careful examination of the *entire farm as a unit*. The use with the highest economic rating should be selected unless there is good reason to do otherwise. Present use, if pasture, does not by itself justify the use of the pasture rating.

Where the trees are of sufficient density to prohibit a good grass vegetation, the timber rating should be used. After studying the aerial photos in the field, it is possible to predict this condition from the photos with a fair degree of accuracy. From time to time, some areas will need to be checked in the field. Scattered trees do not justify the use of the timber rating.

Many areas of highly productive soils need a pasture rating because circumstances make it impractical to cultivate them. The more common reason is that the adjoining soils are unsuited to cultivation, for example, stony land, and the area in question is too small or inaccessible from the farmstead. Roads, streams, and railroads may have the same effect. Actually, in such isolated areas the production costs have increased sufficiently to make pasture the use with the highest net income.

Although each 40-acre tract must be evaluated separately, the most feasible use of each area can be determined only as it fits into a specific operating unit. Many isolated areas within a 40-acre tract are too small to be cultivated, but they may be a part of a much larger area on the same farm.

The economic rating for the taxable tract, usually 40 acres, must be multiplied by some constant to obtain the unadjusted assessed value of the land. Then, this value must be adjusted for the other factors affecting land value. The selection of the constant used to obtain the unadjusted assessed value of land is tied to the selection of the general level of land value to be used for assessment. The place of farm sales in connection with this problem and also their use as a test of the procedure will be considered in the next section.

Farm Sales and Their Use

Farm sales provide a test of the efficiency of the assessment procedure, and also, information useful in the selection of the general level of value to use. The success of any procedure is the conformity of the assessments to the legal standard enacted by the state legislature. In most states, the legal standard is market value based on bona fide sales and such factors as income and reproduction costs. Since land does not have a reproduction cost, and since average income figures are difficult to obtain, the best check on assessments is that provided by bona fide sales.

A group of sales, rather than a single sale, is needed to make a valid assessment check. Any one sale, even though it is a bona fide transaction,

provides practically no assistance for checking purposes because the complex circumstances surrounding a sale make it difficult to determine how bona fide the transaction is. Only when sufficient sales have been obtained to give a reliable average is it possible to get good assessment-sale and other comparisons.

In order to check the assessment procedure against the opinion of the buyers and sellers of land, 176 bona fide farm sales were located among the sales during the period from January 1, 1949 to June 1, 1953.

The relationships between the economic rating (X) and the sale price (Z) of those farms with buildings were first studied. The yearly regressions are given in Table 2 and illustrated in Figure 4. These regressions were

TABLE 2. YEARLY REGRESSIONS OF SALE PRICE ON ECONOMIC RATING OF 137 FARMS WITH BUILDINGS, ALLAMAKEE COUNTY, IOWA, JANUARY 1, 1949–JUNE 1, 1953

Year	Regression	No. of Sales	Mean Economic Rating
1949	$Z=-22.5+3.237X$	39	35
1950	$Z=-3.9+3.102X$	36	38
1951	$Z=13.1+3.109X$	31	34
1952	$Z=5.4+3.078X$	23	37
1953	$Z=-18.5+3.806X$	8	29

all highly significant except the one for 1953. The price of land increased from 1949 to 1951 and then dropped some in 1952. The mean economic ratings suggest that the quality of land sold in 1950 and 1952 was slightly better than that sold in the other years. The nearness of these regressions to the origin and their statistical significances indicate good agreement between the economic ratings and the sale price.

Hansmeier made an adjustment for location in his building assessments. Therefore, the relationship between the economic rating and the sale price with the assessed value of buildings deducted was studied. The 100 percent assessed value of the buildings was subtracted from the sale price of the farm and the result was divided by the size of the farm to obtain what we will refer to as the adjusted sale price per acre of the land. Farms without buildings are included. The linear regression of the sale price on the economic rating of the farms was calculated for each year. The regression coefficients of the 5 yearly linear regressions did not differ significantly but the adjusted means did. Therefore, the sale prices were adjusted to an average level and the regression of all sales was calculated. It is shown in Figure 5 and is highly significant. This regression shows the relationship between the adjusted sale price of land (Y) and the economic ratings (X) during the period studied. In general, the agreement is good. The regression through the origin

$$Y = 2.367X$$

is the more valid one, if one accepts the economic rating as the best estimate of the relative economic productive capacities of the soils in the county. The difference between the two regressions represents the effects of the other factors influencing land values. If the two regressions had differed widely, and if a reasonable explanation of the difference could not

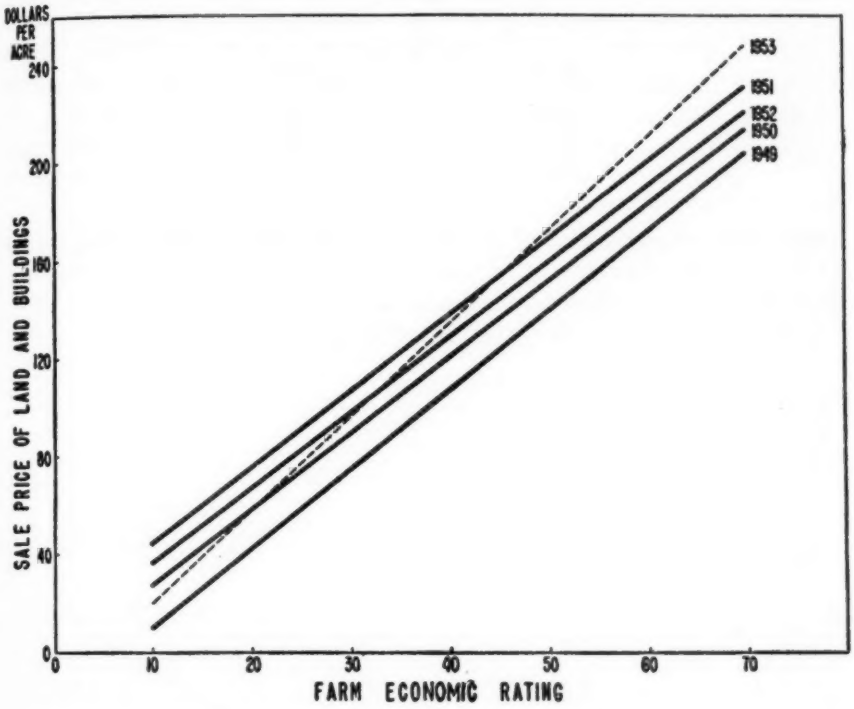

FIGURE 4. YEARLY REGRESSIONS OF SALE PRICE ON ECONOMIC RATING OF FARMS WITH BUILDINGS SOLD IN ALLAMAKEE COUNTY, IOWA, 1949-1953.

have been made on the basis of the other factors, the economic ratings would need to be reexamined.

The regression of the sale price (Y), adjusted for price level changes, of the 39 farms without buildings on the economic rating (X) was

$$Y = 0.8 + 2.379X.$$

It is nearly the same as those in Figure 5, thus providing evidence to support Hansmeier's building assessments.

Next, the ratio of economic rating to the adjusted sale price of land was calculated for each farm, and also the regression of these ratios (R) on the economic ratings (X). The resulting regression was

$$R = 55.4 - 0.2083X$$

and it was significant. The difference between the first and fourth quartile (see Table 3) is 8. While this difference is small, it does suggest a possibility of further improvement. Perhaps the buyers put different values on the buildings and the location than Hansmeier. As indicated

TABLE 3. ECONOMIC RATING—ADJUSTED SALE PRICE OF LAND RATIOS RANKED ACCORDING TO ECONOMIC RATINGS OF 176 FARM SALES IN ALLAMAKEE COUNTY, IOWA, 1949–1953

Quartile	Ratio
First	51
Second	54
Third	46
Fourth	43

earlier, Hansmeier included in the assessed value of the buildings an adjustment for location. The principal factor he emphasized was the difficulty of getting from the farmstead to a good road.

If the buyers placed more emphasis on good buildings because of the

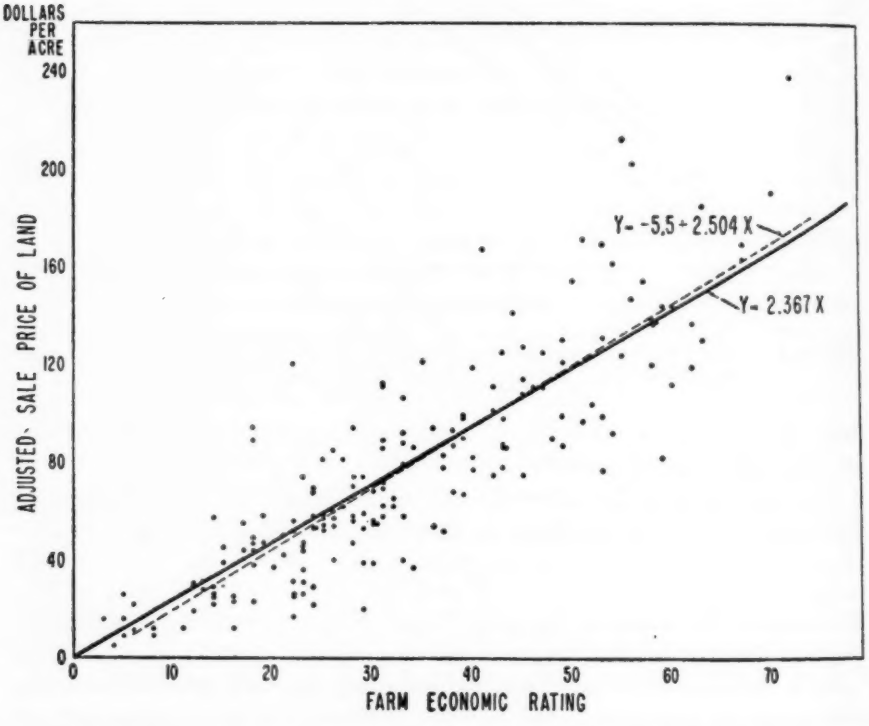

FIGURE 5. RELATIONSHIP OF THE ADJUSTED SALE PRICE OF LAND TO ECONOMIC RATING OF 176 FARM SALES IN ALLAMAKEE COUNTY, IOWA, 1949-1953.

current high building costs, the ratio should be lower on those farms with the higher assessed values of buildings. The regression of the ratio (R) of those farms with buildings on the 100 percent assessed value of the buildings (B) was

$$R = 53.4 - 0.00132B.$$

The regression was not significant, the F value being 1.5. It should be noted, however, that the regression coefficient was negative. Another interesting point is that the average ratio of the farms without buildings was 46.0 which is less than the mean of the regression, 49.4. Possibly, buyers have a definite preference for farms without buildings and for farms with better than average buildings.

A comparison of assessment-sales ratios for the 1949 and 1953 assessed values is given in Table 4. These indicated a big improvement in the 1953

TABLE 4. ASSESSMENT-SALES RATIO OF 96 FARMS SOLD IN ALLAMAKEE COUNTY, IOWA, DURING 1949 AND 1950 RANKED ACCORDING TO ECONOMIC RATING

Quartile	Assessment-Sales Ratio	
	1949 Assessment	1953 Assessment
First	70	47
Second	48	46
Third	47	42
Fourth	37	38

assessment. While the analysis showed some differences between the assessed values and opinion of the buyers, we are not sure that the same emphasis should be placed on all factors by the assessor as placed by the buyers in the market place. This may well be a question to be answered by the local people.

RECLAMATION UNDER THE DESERT-LAND ACT

KARL S. LANDSTROM*

AFTER a flourishing epoch lasting half a century, disposals of public lands by reclamation under the Desert-Land Act declined sharply during the first World War. In 1937, Professor Ganoe, writing in "Agricultural History," concluded that the "era of the Desert-Land Act as an important policy for reclamation of arid lands was now over."[1] A new surge of interest has occurred, however, and there is a current heavy volume of applications. In the year ending June 30, 1953, 3,280 desert-land applications were filed, exceeding the number filed for homestead entries, public-land sales, small-tract sales, exchanges, or any other single class of land disposals administered by the Bureau of Land Management.

This article traces the general developments under the act, analyzes the origin and economic significance of the current developments, outlines certain economic and administrative problems, and discusses the outlook for future developments.

General Developments under the Act

The Desert-Land Act of 1877 was intended originally to promote the reclamation of arid and semi-arid public lands by making them available for privately-managed irrigation developments. Under the act, a total of 10,042,787 acres of public lands had been patented or approved for patent through June 30, 1953. Large areas in certain Western valleys, such as the Salt River of Arizona, the Imperial of California, the Snake River of Idaho, the Gallatin of Montana, and the Yakima of Washington were patented under the act. Federal projects under the Reclamation Act of 1902 were later constructed in many of these valleys to supplement the water supplies and to reclaim additional lands.

Professor Ganoe traced three epochs under the Desert-Land Act to 1914. The first of these, up to 1887, was characterized by extensive disposals to cattlemen, many of whom allegedly obtained the lands by fraud with no intention of reclamation.[2] A decrease in the number of original entries occurring in 1887 was reported by the Secretary of the Interior as being due to newer methods that had been adopted by the General Land Office to prevent fraudulent entries.[3]

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* Program Coordination Officer, Bureau of Land Management. The views expressed are those of the author and not necessarily those of the Bureau of Land Management or the Department of the Interior.

[1] John T. Ganoe, "The Desert Land Act Since 1891." *Agricultural History*, 11:266-277, 1937.

[2] John T. Ganoe, "The Desert Land Act in Operation, 1877-1891," *Agricultural History*, 11:142-157, 1937.

[3] Department of the Interior, Annual Report, 1:6, 1887.

Fraudulent entries have not been limited to this first epoch. In his book on irrigation policy, Professor Huffman writes that he is personally familiar with a tract of land that was acquired under the Desert-Land Act where the irrigation ditch is a plow furrow beginning at a diversion on a dry stream bed and ending on a hill that is 25 or 30 feet higher in elevation than the alleged water supply.[4]

A second epoch, from 1888 to 1893, began with the decline of the Western cattle industry, and ended with the 1893 depression. An amendatory act, approved March 3, 1891, required a showing by an entryman as to how he intended to irrigate the land, provided for the filing of joint or association irrigation plans, required minimum annual and total reclamation expenditures, limited entries to individual citizens, and extended the operation of the act to Colorado.[5]

A third epoch began about the turn of the century, with the return of prosperity and revived interest in irrigation. The annual number of original entries increased rapidly to a peak of 15,620 in 1910. The act of March 28, 1908, provided that no assignment of an entry would be recognized unless the assignee was eligible to make an entry, and that entries could not be made on unsurveyed lands. This epoch ended about 1914, when the market for irrigation company securities collapsed.[6]

The number of original desert entries per year fell off rather steadily after 1914. This declining period witnessed considerable development under the act within State irrigation districts. Under the act of August 11, 1916, such districts, when approved by the Secretary of the Interior, were authorized to apply their liens to the public lands within unperfected entries. A total of 62 State districts have been approved under this authority.

Annual activity under the Desert-Land Act reached an all-time low in the year ending June 30, 1946, when only four original entries were allowed and only 10 final entries were approved by the Bureau of Land Management.

Recent Developments under the Act

The recent renewal of activity under the Desert-Land Act is a part of the general upsurge in farm-land development stimulated by higher farm real estate values and favorable ratios of farm commodity prices to farm production costs. Important specific factors influencing added desert-land

[4] Roy E. Huffman, *Irrigation Development and Public Water Policy*, The Ronald Press Company, New York, 1953.

[5] John T. Ganoe, "The Desert Land Act in Operation, 1877-1891," *Agricultural History*, 11:142-157, 1937.

[6] John T. Ganoe, "The Desert Land Act Since 1891," *Agricultural History*, 11:266-277, 1937.

development include the greater technological efficiencies in well drilling, pumping, and irrigating; the extension of rural electrification; and the general improvement in desert living opportunities through such means as highways, refrigeration, and air conditioning.

It is unlikely that the current revival will develop into a major epoch in reclamation history. The resurgence has shown, however, that private initiative under the Desert-Land Act still has a role to play in Western reclamation development.

Unlike earlier surface-water reclamations under the act, the present developments are mostly by pumping from ground water. The bulk of the new demand has been centered in certain ground-water basins in California, Idaho, and Arizona. Substantial demand has existed also in Nevada and New Mexico. Smaller demands have developed in Colorado, Montana, Oregon, Utah, and Wyoming. In the State of Washington, practically no interest has been shown.

In the five fiscal years 1949-1953, the greatest development under the act was in Idaho, with approximately 80,000 acres of entries allowed. In California, there were approximately 60,000 acres. In all other States combined, the area allowed was approximately 50,000 acres.

In the five fiscal years 1949-1953, a total of 189,869 acres was classified by the Bureau of Land Management as suitable for disposition under the act, out of 530,693 acres applied for or otherwise considered for classification.

Recent reclamations under the Desert-Land Act have had particular significance in an area such as the Snake River basin in Idaho, where unused ground-water resources in public-land areas are known to exist. Irrigation began in the Snake River basin in the 1860's. Nearly all of today's irrigated area was developed by 1920. Development thereafter was much slower, primarily because the newer surface-water projects tended to involve successively higher costs.

In the past five years, there has been a decided trend toward ground-water development in the Snake River Plain, amounting to approximately 150,000 acres of new farm land. A recent survey in Bingham County showed that about 35,000 acres of desert had been developed in the county by the use of wells since 1948. The average cost of drilling the wells and providing the pumping equipment was about $35 per acre. The main crops grown on the new lands are potatoes and small grains, with some sugar beets and alfalfa. Potatoes have been favored because of the low farm capital requirement and the good cash returns in the main. Ground-water development in this area undoubtedly will continue until its full potentialities are realized.

Few surface-water developments remain in an area such as the Snake

River valley that would be feasible without considerable financial assistance. The direction and extent of surface-water reclamation in an area such as this is largely controlled by Federal policy toward this type of public works.

Administrative Procedures and Problems

An upsurge of desert-land and other applications beginning about 1950 found the Bureau of Land Management with inadequate staff to handle the workload expeditiously. Complicating factors, including a general lack of basic hydrologic data concerning certain Western ground-water basins, specifically hindered the processing of desert-land applications. In March 1954, the Bureau had a total of 4,192 new and reactivated desert-land cases awaiting decision, exceeding the number of any other type of cases

TABLE 1. PUBLIC LANDS CLASSIFIED AS SUITABLE AND NOT SUITABLE FOR DISPOSITION UNDER THE DESERT-LAND ACT, JULY 1, 1948–JUNE 30, 1953

State	Classified as suitable for disposition	Classified as not suitable for disposition	Total
	(Acres)	(Acres)	(Acres)
Arizona	16,804	96,499	113,303
California	60,900	79,870	140,770
Colorado	877	1,040	1,917
Idaho	79,196	42,036	121,232
Montana	397	320	717
Nevada	18,670	35,037	53,707
New Mexico	316	70,078	70,394
Oregon	1,400	2,600	4,000
Utah	6,726	10,270	16,996
Washington	80	0	80
Wyoming	4,503	3,074	7,577
Total	189,869	340,824	530,693

Compiled from annual reports of the Bureau of Land Management.

involving public-land entry. A total of 1,911 of these cases was held awaiting reports of field examination.

Vacant public lands within the eleven Western States and in the Dakotas may be applied for under the Desert-Land Act by any citizen of the age of 21 or over, and by qualified persons of that age who have filed declarations of intention to become citizens. Except when filing for lands in Nevada, an applicant must be a bona fide resident of the State in which the lands are located. Any citizen may apply under this law for lands in Nevada. Ordinarily up to 320 acres in compact form may be included within an application. Entries are restricted to 160 acres on lands that are withdrawn or classified as containing leasable minerals, or lands that are within irrigation districts approved by the Secretary of the Interior.

Upon filing, the applicant pays 25 cents per acre and upon filing final proof for patent, he pays $1 per acre. These amounts, totalling $1.25 per acre, are the price paid to the Government for lands patented under the act, except where the entry is perfected by commutation or purchase.

By executive orders promulgated in 1934 and 1935, all of the vacant public lands in the eleven Western States, and certain other States were temporarily withdrawn from most classes of disposal pending determination of the most useful purpose to which such land might be put in consideration of the provisions of the Taylor Grazing Act. Section 7 of the Taylor Grazing Act, as amended, authorizes the Secretary of the Interior, in his discretion, to examine and classify any of the lands so withdrawn, or within a grazing district, which are more valuable or suitable for the production of agricultural crops than for the production of native grasses and forage plants, or more valuable or suitable for any other use than the use provided for under the act, or proper for acquisition in satisfaction of outstanding rights or grants, and to open such lands to disposal under applicable land laws.

When an application is filed with the Bureau of Land Management under the Desert-Land Act, the application is considered also as a petition for the classification of lands under the Taylor Grazing Act. Classification may also be made of lands without an application having been filed. Classification in this sense means an administrative determination under the discretionary authority of the Secretary whether or not the conditions precedent to the opening of the lands, as prescribed by the Taylor Grazing Act, do in fact exist.

Classifications are applied to each of the smallest legal subdivisions (normally quarter-quarter sections) of the lands under the application.

The classification authority of the Secretary was delegated to the Commissioner of the General Land Office (later the Director of the Bureau of Land Management), and has been redelegated to Bureau field officials. By recent order, Bureau of Land Management State supervisors and their designees were delegated the authority to make classifications. The authority to adjudicate applications under the Desert-Land Act for some years has existed in the Bureau of Land Management district land office managers. All field decisions are subject to a right of appeal within certain time limits to the Director of the Bureau of Land Management and to the Secretary of the Interior. Protests may be filed by parties having adverse interest.

For the first time, as outlined above, both classification and adjudication decisions may be made by Bureau offices located within the individual States. This will simplify and expedite action.

Factors Influencing Land Classification

Economic factors obviously are of primary importance in considering land classification decisions relating to the Desert-Land Act. The provisions of law, however, closely control the application of economic factors.

The requirements of the law as outlined above have been assumed by some to imply that, where the Desert-Land Act is concerned, lands to be classified for disposal must unquestionably be suitable for irrigation with little or no risk of failure. Likewise, it has sometimes been assumed that a classification "not suitable for disposal under the Desert-Land Act" necessarily implies that the lands are not feasible of irrigation. Neither of these assumptions is correct.

The central conditions required to be satisfied in determining the suitability of public lands for disposal, as specified by law, are (1) whether the lands are more valuable or suitable for the production of irrigated crops than for the production of native hay and forage plants or any other use provided under the Taylor Grazing Act; and (2) whether there is any other condition that would reasonably require that the lands remain in withdrawn status under the discretionary authority of the Secretary. Under the discretionary authority, lands may be classified for retention as Federal holdings because of conditions that may have little relationship to irrigability. On the other hand, lands may be classified for disposal even though their irrigability has not been firmly established.

In a decision in the cases of Ezra M. Carter and Harry Fogliatti, A-26165, A-26191, decided October 5, 1951, the Acting Solicitor of the Department of the Interior described the element of risk in desert-land entries in the following language:

"In affording to individuals an opportunity to obtain patent to valuable lands by reclaiming them, the Congress is inviting the adventurous to a precarious enterprise. The regulations warn the applicant that the reclamation effort is full of risks, but beyond putting the applicant on guard they do not protect him. They leave it to him to calculate the risks and take or reject them, as he chooses. The regulations are liberal toward the applicant in allowing him to enter the land if there is plausible presumptive evidence that he will have an adequate and constant water supply for its reclamation. But the rules are not tender towards him at the time of final proof if before then some unforeseen eventuality shall have occurred to make reclamation seem impossible. In such case, whether the happening of the contingency result from natural causes or from the interposition of man, the regulations protect the interest of the whole people in their lands and deny patent to the individual despite his disappointment and his loss of time and money."

At one extreme, the law would be complied with in classifying lands for disposal even though there is only a minimum showing of greater value

or suitability for irrigated crops. Some entiries have been allowed partly as explorations to augment the scanty knowledge of ground water.

At the other extreme, the law would be complied with in classifying lands for retention where there is no question of feasibility, but where, however, it is determined that retention is reasonably warranted by other important circumstances. One situation of this type is where the lands applied for are needed for Government purposes such as military uses or experimental projects, and where no alternative sites are reasonably available. If the lands are a so-called "key-tract," essential as part of a range livestock unit, such fact would be given consideration.

Petitions for classification under the Desert-Land Act, unlike those under the homestead laws, are ordinarily considered allowable even though the land to be entered would not in itself constitute a unit having the capability of providing farm-family livelihood. There must be a showing, however, that the lands will produce irrigated crops on a commercial basis.

If there is high development risk involving the questionable availability of ground water, the applicant may be granted a special land-use permit to drill an exploratory well. This ordinarily carries a presumption that the entry will be allowed after satisfactory test of the well. This procedure allows the development of evidence without disturbing grazing or other preexisting uses. The permittee is not authorized to clear the land unless the entry is allowed.

Relationship to Water Conservation

A difficult classification situation that arises is where the proposed developments (usually in combination with others on public and private lands in the same locality) would tend to over-use the supply of local ground water to the detriment of existing water rights or uses. The frequency with which this situation is encountered varies by States and localities due to differences in the physical ground-water conditions and the effectiveness of State water conservation laws.

It is well established by decisions of the Department of the Interior that desert-land applications may be rejected where the entries, if allowed, would seriously damage water users.

In the case of Robert Charles Powell, A-25828, decided April 7, 1950, the Solicitor held that ". . . it does not seem proper or in the public interest for the Department to classify a tract of land as proper for desert-land entry under section 7 of the Taylor Grazing Act . . . when it clearly appears that the ultimate end will be disastrous to the applicant and to his neighbors." The lands within this application were located in an area where it was definitely known that the ground water was being exhausted many times faster than the recharge rate.

In the case of George Brown and Kenneth Lee Brown, A-26422, decided December 2, 1952, it was held that "The rejection of applications for entry under the Desert-Land Act is proper where it appears that available irrigation water is insufficient for additional crop production without endangering the supply of those now dependent on ground water in the area for irrigation."

On the other hand, in the Carter and Fogliatti decision, it was held that "Where the drilling of wells on nearby lands indicates that satisfactory irrigation water may be obtained at reasonable cost from underground sources for the desert lands sought, denial of entry on the ground that third parties using nearby surface waters may seek to enjoin development of the ground water is error." In this case it was ruled that the contingency of litigation was remote rather than probable.

The discretionary provision of the Taylor Grazing Act permits classifications to be made in such a way as to promote the general economic interest. The guiding principle as stated by Edward Woozley, Director of the Bureau, is that the Bureau "must be ever on the alert respecting the interest of the man who is applying for a desert-land entry and at the same time taking into full consideration increasing ground-water problems in the Western States. . . ."[7]

Outlook for Future Developments

Over-all results are that only one out of three original desert entries has reached fruition into a patent. The classification provision of the Taylor Grazing Act provides that certain resource and other conditions must be met before an entry may be allowed. Consequently a higher ratio of success may now be expected. Basically, however, desert-land entries are speculative ventures. The record of economic progress made by the current entrymen will be a major factor influencing interest in future developments. A research project to determine accurately the degree of economic success would be a valuable source of needed information.

The Bureau of Agricultural Economics has estimated that, if aggregate population growth continues at the current rate, greater aggregate demands for farm products within the next decade may about absorb the increased productivity on existing farm lands to a point where more improved cropland will be needed. It is cautioned, however, that investment in development of new lands should be made only when it is clearly justified by increased requirements and greater efficiency in the use of resources.[8] Reclamation of productive arid and semi-arid public lands by private capital under the Desert-Land Act is one of the means by which

[7] Edward Woozley, "Logan Conference," *Our Public Lands*, 4:8-9, January 1954.

[8] H. H. Wooten, *Major Uses of Land in the United States*, USDA Technical Bulletin 1082, October 1953, p. 83.

the requirement of additional cropland acreage may be satisfied. There is a tendency, however, for some applicants to attempt the reclamation of lands that are of low or marginal capability.

Further efficiencies in well drilling, pumping, and distributing systems will tend to stimulate desert-land development. A continuing deterrent is the unexplored or undetermined ground-water characteristics of many Western basins. Another unknown is the extent to which reclamation of public lands by private capital under the Desert-Land Act may become a substitute for reclamation of such lands by the Government under the Reclamation Act.

Certain Reclamation Act projects include among their features the reclamation of public lands by pumping from ground-water sources. In some instances, canals would be constructed to provide community water deliveries similar to those in surface-water projects. In others, deliveries would be made by pipelines. Where local ground waters are to be used, it may be particularly important to consider the alternative of private development.

The extent to which public lands which are feasible of development from local ground waters may be released from Reclamation withdrawal and may be opened to private entry under the public-land laws will have an important effect upon future reclamations under the Desert-Land Act.

NOTES

METHODS OF INCREASING DOMESTIC CONSUMPTION OF FARM PRODUCTS

UNITED STATES farmers will probably produce 3 to 5 percent more farm products annually in the next few years than can be sold at stable or slightly lower prices. We now have on hand excess stocks from our 1952 and 1953 crops equivalent to 5 to 10 percent of our annual output.

It is the purpose of this paper to indicate the main lines of action of an agricultural policy which would minimize the price depressing effects of this excess production. The lines of action outlined in this paper, however, will be limited to activities designed to make the commercial production and marketing system work more effectively in the domestic market. The possibilities and problems of supplementary government financed distribution plans such as special food stamps or a national food allotment program would require another equally long paper. Proposals for the expansion of foreign markets or increased use of surpluses for foreign relief feeding are also omitted.

While the precise amount of the excess production will depend on the weather and world economic developments there is a broad economic basis for expecting United States food supplies to press on available markets for an indefinite period ahead.

On an individual farm basis it continues to be profitable to make new output-increasing investments in agriculture even though farm prices decline further. In every section of the United States many individual farmers can increase their net income by additional investments in fertilizer, soil improvements, improved seeds, pesticides and in many cases by additional investments in machinery, improved breeding stock and buildings. This situation will continue in the years ahead as research and experience demonstrate the feasibility of additional new techniques. Another factor of great importance is the fact that most cost reduction techniques are also output increasing. Farmers for the most part can only lower unit production costs by techniques which increase output per acre and per man.

The relatively inelastic demand for farm products and high ratio of production costs to market prices results in a short-run drop in farmers' net income of 15 percent or more when farm output exceeds normal by 5 percent.

An agricultural policy designed to increase domestic consumption of farm products by making the commercial production and marketing system work more effectively must include:

(1) Special promotional campaigns to increase demand for those products having the most elastic demand.*
(2) Special research and service programs to lower marketing costs and improve distribution facilities, especially for the products having the "more elastic demand."*
(3) Production and marketing restrictions to stabilize the production and supply of individual farm products in relation to market outlets.
(4) Special research programs to develop new industrial uses for farm products.

Commodities Meriting Special Attention

From a National policy standpoint major attention should center on cotton, food and feed grains and livestock products. These are the large acreage using crops. Individual fruits and vegetables may get into economic difficulty from time to time but they are produced on such limited acreages, and are so much subject to variations in weather that marketing agreements and emergency surplus-removal purchases appear to be the only feasible methods for dealing with their supply and market outlet problems. (Perishability is also a factor.)

In the calendar year 1952 livestock and livestock products sold accounted for 42 percent of the cash receipts from farm marketing. Cotton and food grains each accounted for 8 percent, making a total of 58 percent of cash farm income from these sources.

They are even more important from the standpoint of land utilization. Taking into account the pasture, hay and feed grains utilized by livestock, 72 percent of the land in farms in 1950 was utilized for the support of livestock. In addition some 400 million acres of non-farm range land were grazed by sheep and cattle. Food grains were grown on 6 percent and cotton on 2 percent of the farm land, resulting in a total of 80 percent of the farm land utilized in 1950 for these three lines of production.

Since the domestic demand for livestock products is much more elastic than the demand for cotton or food grains, agricultural programs should discourage their production at current levels. It should encourage a shift from cotton and feed grain production to the production of soil-building forage crops. These forage crops will be utilized, in part at least, for livestock production.

As one means of holding livestock expansion in check as much as possible (because of excess production in relation to available markets) some shifts from feed grain to forage production also should be encouraged. Increased acreages of soil holding and soil-building crops would both reduce soil losses and keep the supply of livestock feed from being as large as it otherwise would be.

* Most capable of expansion of consumption.

Possibilities of Increasing Consumption of Livestock Products

Unless new industrial uses for wheat and cotton are found, it is unlikely that the per capita domestic demand for these products can be increased significantly. In fact, research and promotional efforts will be required to maintain current per capita levels of wheat and cotton consumption. On the other hand in the past 20 years there has been an upward trend in the per capita consumption of meats and other livestock products.

Per capita consumption of selected livestock products 1940 and 1953 are shown below:

	1940	1953 Preliminary	Percent increase
Beef, pounds carcass weight	54.2	76.3	40.7
Veal, pounds carcass weight	7.3	9.4	28.7
Lamb & Mutton, carcass weight	6.5	4.7	27.7[a]
Pork, pounds carcass weight	72.4	63.6	12.2[a]
Total meat, carcass weight	140.4	154.0	9.7
Chicken, pounds	13.9	22.8	64.0
Turkey, pounds	2.9	4.1	41.3
Eggs, number	314	401	27.7
Fluid milk & cream, pounds	331	352	6.3
Cheese, pounds	5.9	7.0	18.6
Ice cream, product wt. pounds	11.2	17.0	51.7
Butter, actual weight pounds	16.7	8.6	48.6[a]

[a] Denotes decrease.

There is no evidence that this upward trend in the consumption of livestock products should stop at this point. Such evidence as is available suggests that the upward trend in the consumption of most of these products will be continued if supplies are available at satisfactory prices.

Expanding Commercial Markets for Livestock Products

Several reasons have already been advanced as to why government efforts to assist farmers in keeping supplies in balance with market outlets in the next few years should put major emphasis on expanding domestic markets for livestock products. A number of different activities could well be undertaken. The following listing is suggestive rather than exhaustive.

(1) Expand the coverage of the school lunch program which now only reaches around 30 percent of our children.
(2) Expand in-plant feeding programs by educational and service assistance.
(3) Assist private processing and marketing firms in their development of

packaging and merchandising programs to place high quality livestock products before consumers at lower prices.

(4) Expand educational programs on the nutritive value of livestock products, and recipes and meal planning which feature the use of livestock products.

Relative Importance of Increased Consumption of Specific Products

Each dollar spent in the grocery store for choice beef, at 1953 average prices, purchased the equivalent of 29 pounds of feed grains. On the other hand a dollar spent in the grocery store for either eggs or poultry purchased the equivalent of only 11 pounds of feed grains.

The pounds of feed grains used to produce $1 worth of several different livestock products at retail in 1953 according to U. S. D. A. studies is as follows:

Beef, choice grade	29 pounds
Pork	15 "
Milk, fluid	12 "
Eggs	11 "
Chickens, frying	11 "

A per capita increase of $1 per capita spent at retail for each of these 5 products at 1953 price levels would increase feed grain consumption 6.3 million tons. This is equivalent to around 5 percent of our average production of feed grains.

Even though there is some increase in feed grain and forage production as a result of shifts out of cotton and wheat, an increase of $1 to $2 in per capita expenditures for these 5 livestock products would absorb all excess output in most years.

In terms of consumer acceptance, promotional programs would probably be most effective in moving increased quantities of feed grains into human consumption in the form of grain-fed beef and pork.

WALTER W. WILCOX

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SOME BASES FOR AND OBJECTIVES OF FARM MANAGEMENT EXTENSION WORK

Introduction

THE foremost purpose of educational activities in agricultural economics is to raise the level of economic literacy of the users of economic information. "The job of extension workers is to aid the farmer to apply that kind of knowledge which will help him to succeed."[1] The

[1] Dr. I. O. Schaub, *Agricultural Extension Work, A Brief History*, N.C. Extension Circular No. 377, November, 1953.

broad function of extension education involves helping people learn to help themselves—learn how to solve their own problems.

The major purpose of the cooperative extension work as stated in the Smith-Lever Act of 1914 was "to aid in diffusing among the people of the United States useful and practical information on subjects relating to agriculture and home economics, and to encourage the application of the same." This objective seems to imply equal consideration for both producers and consumers of agricultural products.

Producers and consumers alike must make decisions of various types and magnitude in connection with their wealth-getting and wealth-using activities. Presumably there is an objective associated with such decisions –the maximization of satisfaction in some form. For the consumer, measurement of satisfaction may take a different form than for the producer. This digression is intended merely to emphasize that the farm family household embodies all the elements of both producing and consuming economic units, and between which conflicts in the "means-end scheme" to maximization of satisfactions may occur.[2] In any event, the existence of risk and uncertainty requires an element of management which must assume the responsibility for decision-making. We shall confine our discussion to that element of management associated with the actual operation of farm (production) units.

Characteristics of Management

Management decisions at the farm level are complicated by innovations, changes in prices, personalities and institutions. Johnson has differentiated five functions of management:[3] (1) observation, (2) analysis, (3) decision-making, (4) action, and (5) bearing responsibility. The first two functions provide the bases for (3) and (4) and the fifth implies a willingness and ability of the manager to carry out the other functions effectively within the environment of a dynamic economy.

Raising the economic literacy of farmers in general does not necessarily mean that their prowess in the realm of decision making will be invincible. However, if they are trained in what to look for (observations of technical and economic importance in their particular operations), given a workable understanding of basic analytical tools, and trained to evaluate the economic consequences of alternatives, they will need fewer "prescriptions" and more information on which to base "rational" producer descisions.

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[2] John M. Brewster and Howard L. Parsons, "Can Prices Allocate Resources in American Agriculture," *This Journal*, November, 1946. p. 943 f.

[3] Glenn L. Johnson, "Handling Problems of Risk and Uncertainty in Farm Management Analysis," *This Journal*, December, 1952. p. 807 f. Also see Lawrence A. Bradford and Glenn L. Johnson, *Farm Management Analysis*, New York: John Wiley & Sons, 1953. Chapter 3.

An extension educational program in farm management, to a large extent, involves an interpretation and dissemination of information of technological developments and economic, social and political trends or events to every level where production decisions are made. Such an assertion is not meant to imply that information influencing production decisions must be interpreted to every individual situation. To follow such a course would be an absurdly burdensome attempt on the part of any educational agency. Haver points out that "continual learning and adjusting on the part of the manager in a situation of change and imperfect knowledge is of prime importance."[4] If logical action is expected, then it would appear that emphasis must be extended in the direction of helping farmers to learn how to arrive at rational decisions. The realization of this objective may result in an increased demand on the part of farmers for economic and technical information of greater scope and depth than has been provided in the past.

Objectives

It is difficult to state the objectives of an extension farm management program without some reference to the level at which the program is being conducted and the techniques or methodology involved. Extension workers have a particular function or functions to perform, depending upon their level of operation. In general, the responsibilities of Extension workers are outlined in the "Report of the Southern Regional Workshop," June, 1947.[5] It is not the purpose of this discussion to review the contents of that particular report. However, for purposes of establishing the relationship that necessarily exists in a properly coordinated extension program, one must remember that the job of an Extension specialist, regardless of his subject-matter speciality, is to facilitate the work of the county agent and to coordinate the subject matter taught with and between the various research and teaching divisions of the land-grant college.

Our statements with respect to the objectives of farm management extension work are not a claim to any originality. In fact, they may appear to be more a result of administrative desires and/or established customs than real imagination and accepted economic principles. Notwithstanding custom, tradition, and economic or administrative dictation, the over-all objectives appear to hinge upon the following considerations:[6]

(1) The economic welfare of individual farm families.

[4] C. B. Haver, "Discussion" of paper by Johnson. *Ibid.*

[5] "Report of the Southern Regional Workshop for Agricultural Extension Specialists," June, 1947, North Carolina Agricultural Extension Service, Raleigh, North Carolina.

[6] Earl O. Heady, *Economics of Agricultural Production and Resource Use*, New York: Prentice-Hall, Inc., 1952. Chapter 27, p. 827.

(2) The economic welfare of agriculture without reference to individuals or groups of individuals in agriculture.
(3) The economic welfare of society in general.

With the above considerations as a background, the following over-all objectives of an Extension farm management program are proposed:

(1) Help farm families in agriculture determine what their economic opportunities are from the standpoint of enabling them to make rational production decisions with respect to:
  (a) Whether to engage in agricultural endeavor.
  (b) Choice of enterprises and quantity to produce.
  (c) Combination of factors, including the level of practices employed and the correct allocation of resources.
(2) Keep farmers informed of the economic implications of changes in policies and programs which impinge on decisions at the firm level with respect to adjustments in farm organizations and operations.
  (a) Suggest practical alternatives that may be open to farmers under given situations.
  (b) Teach farmers the essential techniques of analysis for determining the possible consequences of likely alternatives from which they may choose.
(3) Ascertain the location and nature of problems facing farmers which may require more detailed study before logical alternatives can be suggested to guide them in their decisions with respect to farm reorganization and production adjustments.

  This objective is viewed as a coordinated function of extension workers at all levels, but also would require coordination with farm leaders, other agricultural agencies, business interests and of the Agricultural Experiment Station. Although it might be viewed as a separate objective, efforts to guide the agricultural development of different areas or the state as a whole, appear to be closely associated with the proper integration of research and extension education. From the standpoint of an extension farm management program, it is believed that encouraging production in areas and on farms where products can be produced most efficiently, consistent with institutional or other limitations, should be considered not only as an objective but as a responsibility.
(4) Assist in acquainting other economic groups with both the internal and external economic aspects of agriculture, including the implications and consequences of changes in policies and programs relating directly or indirectly to agriculture, economic development in agricultural areas, and other phenomena which influence the decision-making process of economic units.

  Admittedly, such an objective extends far beyond the realm of the purely farm management aspects of an extension program, but the economic implications of markets, labor supply, credit and the factor market in general cannot be divorced from the choices and decisions to be made at the farm level.

It is believed that the above objectives are reasonably compatible with the welfare considerations suggested, although some inconsistencies

naturally arise between the interests of individuals and larger groups. It is difficult to see how this can be avoided entirely, which accounts partly for the necessity of continual adjustments at the firm level. For this reason the first two objectives as stated appear to rate some priority from the standpoint of the extension farm management program, including the activities of both the county agricultural workers and specialists.

An attempt to outline additional objectives resolves itself largely into statements of *functions* or *responsibilities* of workers at different levels, or suggestions as to the method of, and techniques for, achieving the objectives already presented. The following activities are suggested for consideration:

(1) Assemble and disseminate information which can be resolved into logical alternatives as a basis for choice and action.
(2) Develop effective methods or techniques for acquainting farmers in the aggregate with useful information so as to facilitate the actual learning and using processes of farm managers on as broad a scale as possible.
(2) Train county agents and other extension personnel in the use of farm management principles, methodology, and techniques; and, in this connection, to assist the agents with specific and/or special problems in the area of decision making.
(3) Work with representatives of other agricultural agencies, private business firms serving farmers, and farmer organizations on problems and programs where farm management information and techniques can make a contribution to economic progress.

Summary

Embodied in the suggestions offered is the assumption that the educational activities of the Agricultural Extension Service are intended to stimulate rational behavior on the part of decision-making units. There is one basic principle which must be observed by all personnel contributing, directly or indirectly, to the assembly and dissemination of information for use of economic groups. Information that is not sufficiently effective, both as to content and method of presentation, to stimulate rational decisions on the part of the recipient, falls short of the real objective of education.

Any information considered essential to the achievement of the objectives that have been suggested in these notes must contain the vitality of the purpose it is intended to serve. Information without action is futile; action without information may be fatal. "Extension has a growing obligation to help rural people understand the complex social and economic problems . . . which confront them."[7] Our thesis is that an effective extension program in farm management should be directed toward the develop-

[7] "Joint Committee Report on Extension Programs, Policies, and Goals," U. S. Department of Agriculture, Washington, D. C., August, 1948. p. 6.

ment of rural people to the end that they, "through their own initiative, may effectively identify and solve the various problems directly affecting their welfare."[8] Changes in economic conditions and technology, or modifications in institutions, need not alter the objectives materially but may require changes in the amount and kinds of information and method of presentation to fulfill the over-all requirements of an effective extension farm management program.

WALTER H. PIERCE
MOYLE S. WILLIAMS

N. C. State College

[8] *Ibid.*, p. 7.

A FURTHER NOTE ON FORAGE-GRAIN SUBSTITUTION

IN A previous article[1] I tried to determine the economic importance of marginal rates of forage-grain substitution[2] and of forage-grain substitution along the stomach capacity line.[3] This was done by applying various sets of prices of milk, hay and grain that have prevailed in Wisconsin to the milk produced and the grain and hay eaten. All of these calculations showed a considerable range (about 900 pounds of grain) of indifference in which the net returns for milk from a 20 cow herd did not vary more than $10 to $40 per year.

Glenn L. Johnson[4] suggests that, "If the results of these computations should continue to hold when complete economic analysis of adequate price and input-output data are made, very practical important changes (based incidentally on the marginal rate of substitution concept) would be called for in the recommended organization of dairy farms, i.e., if a given output of milk can be produced at little change in cost over a wide range of forage-grain substitution, we can discard the long followed recommendation that as much roughage be used as possible because T.D.N. (total digestible nutrients) from hay roughage are cheaper than T.D.N. from grain."

How practical would it be for a dairyman who self feeds hay to 70 cows and scoops the silage with a tractor from a trench silo into bunks in the

[1] Emil Rauchenstein, "Forage-Grain Substitution: Its Importance in the Economics of Milk Production." *This Journal* Vol. XXXV Nov. 1953, p. 562.

[2] Earl O. Heady, "A Production Function and Marginal Rates of Substitution in the Utilization of Feed Resources by Dairy Cows," *This Journal* Vol. XXXIII Nov. 1951, p. 485.

[3] Einar Johnson, et al. *Input-Output Relationships in Milk Production.* U.S.D.A. Technical Bulletin 815.

[4] Glenn L. Johnson, "A Note on Rauchenstein's Article." *This Journal* XXXVI February 1954, p. 130.

paved lot, the whole forage feeding operation taking less than one-half hour per day, to change to a system that requires weighing each feeding of hay and silage to each cow? Waste-proof stalls and mangers would need to be provided or some one would have to see that forage thrown out of the manger was returned to the cow that threw it out.

Feeding cows as much hay and silage as they will eat, at the level of grain feeding that is most profitable, at prevailing prices of grain and milk, is an easy and efficient way of utilizing available forage. The bulk of experimental evidence indicates that cows fed at stomach capacity produce more milk per unit of feed than when forage is limited. Also, if there is plenty of forage, the lower quality material can be fed so liberally that cows can pick out the best of it and leave the rest. This overcomes, to some extent, the bad effect of the lower grade forage.

Some of our greatest opportunities for improving the efficiency of dairy farming lie in producing higher yields of good forage crops, harvesting and storing them with less labor and less waste, self feeding them as much as possible, and increasing the size of the herd to utilize the larger quantities of forage to the best advantage.

Glenn Johnson says that three things were done in my article which reduce the validity of the test:

1. Data were used which were fully recognized by the author to be tentative and inconclusive.

In the articles to which I referred, the tentative and inconclusive nature of the studies was not emphasized to this extent. However, as the data were published, should they not be tested? And if the test shows the data to have little economic significance, is that a reflection on the test? To be sure, one would not be justified in drawing sweeping conclusions from any test of tentative data and this was not attempted.

2. Only the effects of changes in the ratio between prices of the two inputs on the least cost combination were tested. The effect on the most profitable level of output was left out of consideration.

The scale effect was not emphasized in the original article by Heady and it is reasonably certain, from the records of the cows selected, that the effect of cows of different capacities was not eliminated. Hence any increase in income associated with scale effect would be due to a combination of scale effect and higher productive capacity. The separate effect of each cannot be determined.

3. State annual average prices of hay and grain were used, ignoring intra-year variations in hay prices as well as area differences in hay prices known to exist in other states.

In the important dairy areas a lot of forage crops are grown in the form of pasture, hay, and corn silage at relatively low cost. Few cases

have occurred in Wisconsin in which the price of a ton of hay has been more than half the price of a ton of dairy ration. Most annual or monthly hay-grain price ratios fall between .2 and .3. Heady mentions in his opening sentence (This Journal, November 1951, p. 485) that a wave of physical experiments are now under way over the country in an attempt to find ways to utilize additional quantities of forage crops.

However, let's assume prices of hay and grain and price ratios considerably beyond those published for Wisconsin[5] such, for example as hay at $50 a ton, grain (dairy ration) at $60 a ton and milk at $4 per 100 pounds. Applying these prices to the data given by Heady to a herd of 20 cows producing 8,500 pounds of milk gives the highest net return above all feed of $895, at 4,423 pounds of grain per cow. The next lower step, with 4,029 pounds of grain per cow, gives a net return above all feed of $13 less. The next step in higher grain feeding of 4,892 pounds gives $31 less than the high of $895. This covers a range of 863 pounds in grain feeding per cow.

EMIL RAUCHENSTEIN

Agricultural Research Service
Madison, Wisconsin

[5] Walter H. Ebling and Emery C. Wilcox, *Wisconsin Farm Prices, Production and Income.* Wisconsin State Department of Agriculture. Bulletin 249, pp. 1-132. Annual, monthly and area (crop reporting districts) prices are included.

A NOTE ON THE DERIVATION OF A SHORT-RUN SUPPLY CURVE*

THE efforts of research workers in deriving meaningful supply curves by historical-statistical procedure have not been very fruitful. One worker indicates that this can be attributed to the many variables, not present in demand analysis, which must be taken into account in supply analysis—weather, changes in the prices of various cost items, changes in technological processes, etc.[1]

In view of the unsatisfactory results from this approach, alternative ways to derive a supply curve have been attempted. For example, Mighell and Allen attempted to derive a supply curve for milk in a localized area of Vermont by the familiar budget procedure.[2] In this case the supply curve

* The reading of the original manuscript by Professor H. E. Conklin is gratefully acknowledged.

[1] G. S. Shepherd, *Agricultural Price Analysis,* Third Edition, Iowa State College Press, 1950, pp. 90-95.

[2] R. L. Mighell and R. H. Allen, "Supply Schedules—'Long-Time' and 'Short-Time,'" *This Journal,* August 1940, pp. 544-557.

represented a much longer-run period as all adjustments which could reasonably take place within ten years were permitted.

Einar Jensen endeavored to derive a production function for feeding dairy cattle by experimental techniques.[3] Results from such a study can be recast into the familiar cost curves of production economic theory. The portion of the marginal cost curve lying above the minimum point on the average variable cost curve represents the supply curve for milk. In this case, changes in amount supplied can be due only to changes in amount of feed input. Thus the derived supply curve represents responses which are most likely to occur in the short-run.

While it is not possible to evaluate these techniques critically in this note, it is sufficient to say that resources required to carry out such extensive projects are not likely to be available in the amounts necessary to do much of this kind of work. However, from the standpoint of supply analysis, both techniques represent interesting and plausible methods for deriving supply curves.

A third alternative which has received mention but little widespread recognition is the possibility of developing supply curves on the basis of data collected within geographic regions throughout which production conditions are similar, but in which inter-area prices of products differ. Mention of this method of deriving supply curves was made by Shepherd, Jensen and Mighell and Allen in the previous references. This note is largely directed to a discussion of some conceivable applications and limitations of this technique as it might be applied in a milkshed region.

When areas having homogeneous physical resources are selected in a milkshed region, differences in the organization and intensity of farm operation in each area may be attributed to the long-time price differential pattern characteristic of the region. It is proposed that these differences in organization and intensity in space would indicate the direction of changes in farm organization in time if prices were altered. While it would be interesting to analyze many supply responses of this general nature, only one specific response, that of feed inputs to milk production, will be considered here. In presenting the results of this technique our theoretical structure will need to be examined.

To obtain significant results from this technique, it is necessary to assume that the function relating inputs of feed to output of milk is similar between geographic areas within the region. Furthermore, it is assumed that feed prices are equal in each area, but milk prices decline toward areas located on the periphery of the milkshed. Under these assumptions, a short-run supply curve is meaningful only insofar as the rate of feeding is the main response by farmers to short-run changes.

[3] Einar Jensen, "Determining Input-Output Relationships in Milk Production," *This Journal*, February 1940, pp. 249-258.

(Short-run is thought of as the amount of time necessary for farmers to change variable inputs, largely feed, but not long enough for them to react to price changes by altering farm capacity, quality of animals, etc.)

Based on these theoretical assumptions, a model can be constructed showing that as output per cow increases the average cost of feed per hundred pounds of milk produced also increases. Furthermore, it would be expected that in areas with higher product prices the average cost per hundred pounds of milk produced would be greater as the marginal revenue curve (price) would intersect the marginal cost curve at a higher point. These conditions are illustrated diagramatically in Figure 1 for three geographical locations in the milkshed which differ only in prices received.

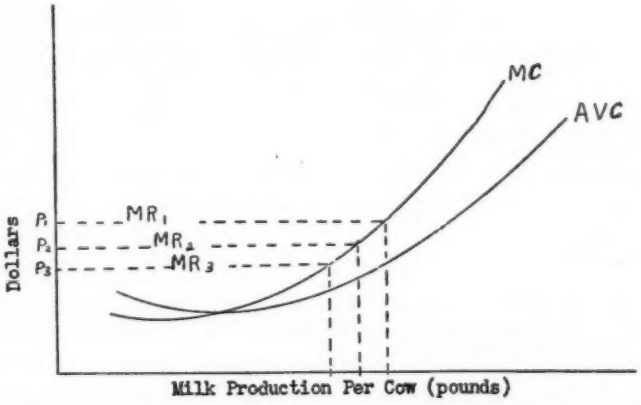

FIG. 1. Expected relationship between price, marginal costs, and average variable costs, in the production of milk in three areas of a milkshed region.

It is noticed that associated with a higher product price; marginal costs, average variable costs and output per cow increase.

It is believed that if conditions such as those imposed by our basic theoretical assumptions could be found in a milkshed region, then a supply curve could be derived from empirical data obtained in such an area. The response of milk production to a change in price would be measured along the marginal cost curve. In deriving the supply curve, it would be necessary to weight the change in production per cow in each area by the number of cows in that area, and then aggregate areas together.

In order to test this technique, the authors used data which had been previously obtained from a survey of large dairy farms in the New York Milkshed in 1949.[4] Records of farms in three different areas of the New

[4] A. J. Ashe, "An Economic Analysis of Large Dairy Farms, New York, 1949-50," Unpublished Ph. D. Thesis, Cornell University, 1951.

York Milkshed were chosen so as to represent the characteristic geographical price differential which exists as the distance to New York City increases. Under the existing conditions in these areas it is reasonable to believe that the above basic assumptions necessary for this technique to give valid results are not violated.

The brief analysis undertaken showing the relationship between the price of milk received, the average variable cost, and output per cow gives some credence to the theoretical model. Results of the empirical analysis are presented in Table 1.

TABLE 1. INTER-AREA RELATIONSHIP BETWEEN PRICE OF MILK, AVERAGE VARIABLE COST, AND OUTPUT PER COW, 1949[a]

Area	Approximate Distance to New York City (miles)	Price of Milk per 100 lbs	Average Variable Cost (Feed cost per 100 pounds of milk).	Output per cow (pounds)
1) Delaware—Schohaire	125	$4.15	$2.83	8,728
2) Chenango	150	4.05	2.50	8,567
3) Oneida—Madison	174	4.02	2.44	7,977

[a] Ten contiguous farms were selected from each area. The thiry records were obtained from a survey of 151 large dairy farms conducted by A. J. Ashe in 1949–50. The data are based on 3.7 percent fat corrected milk.

Prices received in the three areas in Table 1 correspond respectively with P_1, P_2, and P_3 in Figure 1. It can be noticed that as prices increase, approaching the market, both average variable costs and output per cow increase. The relationship shown in Table 1 allows us to derive a supply curve meeting all previously stated assumptions.

The records used were not obtained for the purpose under consideration,[5] yet they do tend to substantiate the position that the procedure outlined may be useful in deriving meaningful supply curves. Even though the assumption of similar production functions between areas may be reasonable, treatment of cows may be such that the response to feed is not fully reflected in the amount of milk produced. Under these conditions the expected relation between prices received and costs would still hold, even though the output per cow may not conform. A possible way to overcome this difficulty would be to express milk production in terms of output per unit of cropland. This procedure would measure the inten-

[5] If purposive records had been obtained, it would possible to insure greater similarity between geographical areas. In New York state a method to insure some degree of similarity between groups of farms in different areas would be to choose farms located in the same land class.

sity of production. Greater intensity would be expected in areas of higher prices. Feed costs would also be higher regardless of whether one cow was being fed close to its limit or several cows were being fed at low levels of feed intake.

While results from this inquiry are not to be taken as final, the objective of this note was merely to indicate a method of deriving a short-run supply curve which has not received wide recognition and which the authors believe offers a possibility.

STANTON P. PARRY
WILLIAM MCD. HERR

Cornell University

AN ECONOMIC ANALYSIS OF THE OPTIMUM LEVEL OF CROWDING THE LAYING FLOCK

THE optimum number of laying hens per unit of housing space may appear on the surface to be exclusively a technical matter. But it is evident upon closer examination that the application of appropriate economic tools can be highly useful in providing the basis for a rigorous solution of this problem.

Two analytical situations may be distinguished in the level of housing problem. First, we can examine the situation where the time period involved is of sufficient length to permit the amount of housing to be varied. Here the problem is one of fitting the amount of housing to the anticipated size of the poultry flock during the expected life of the housing. Next we can take a shorter-run view and assume that the amount of housing space is fixed during the planning period under consideration. This would be the situation prevailing in the short-run on practically all farms. We are interested here only in this latter phase of the problem i.e. in determining the optimum number of birds to put in a laying house of a given size when housing is fixed and limits the size of flock. In analyzing this problem eggs constitute the output and we may look upon the available housing space as the fixed and the hens as the variable factor. With this approach, the determination of the optimum level of crowding involves deriving the factor-product relationship, applying factor and product prices and equating the value of the marginal product with added costs.

Detailed records were available on 62 farm flocks through the Iowa Demonstration Flock program. A number of restrictions were imposed upon the flocks considered in order to assure as much homogeneity as possible in respect to characteristics other than degree of crowding. Only "all pullet" flocks of the light breeds and flocks that were confined during the entire laying period were included. The individual flock reports contained information on the total square feet of floor space used during

each production period, total eggs produced and the number of birds in the laying house on January first.

An *a priori* analysis of the factor-produce relationship precludes a total product curve increasing at either a constant or an increasing rate when a wide range of the curve is considered. While the range of observations available for study was somewhat more limited than would be desirable, an examination of the plotted data from that segment of the relationship observed suggested a function with an elasticity of less than one throughout the relevant range. Hence the function fitted to the data was the second degree polynomial $Y = a + bx + cx^2$ with the total number of eggs during the production period per 100 square feet of floor space the dependent variable and the number of laying hens the independent variable. The relationship existing between the variable inputs of hens (with housing remaining fixed) and total output of eggs as estimated from the data is described by the equation $Y = -2238.42 + 376.28X - 3.28X^2$, where X = birds per 100 square feet floor space, and Y = number of eggs per 100 square foot of floor space.[1]

The marginal physical product relationship can be derived from the total product equation by taking the partial derivative of Y with respect to X. Therefore: $MPP_x = \frac{dy}{dx} = 376.28 - 6.56x.$

These physical relationships have economic significance only as we attach prices to the variable factor and the product.[2] The cost of the variable input in this case consists of a depreciation and mortality charge on the hen plus the feed necessary to support her.[3] While one would expect the declining marginal product to be related to a lower feed consumption and a deterioration in the general health of the birds neither the regression of feed consumption per hen nor the percent of mortality on the number of birds per 100 square feet of floor space was significant at the 5 percent level of probability.[4] Hence the mean feed consumption of 110 pounds per bird and an average mortality of 26% of the hens housed during the production period was used in calculating the cost of housing added birds.

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[1] In the test for curvilinearity, the t value of 1.944 for $b'y2.1$ is significant at the 6 percent level of probability.

[2] This is true within the range of data examined here. Where the factor-product relationship contains a range in which the total product is increasing at an increasing rate (i.e. the average product is increasing) or is decreasing, the physical relationship in itself has economic significance in that it describes limits below or above which production would never be economical.

[3] The analysis assumes that the opportunity cost of any added labor is zero.

[4] The feasibility of the analysis presented here does not rest on a constant rate of increase in mortality and feed consumption. If either rate increased at higher levels of crowding added costs could be computed accordingly.

Prices are attached to both the variable inputs and the product of Table 1. The level of crowding that would maximize returns with housing the limited factor is defined by the point at which the value of the marginal product equals the cost of the added input. It is readily apparent that the optimum number of birds per unit of housing space is not a fixed physical coefficient but is a function of factor-cost product price relationships. The

TABLE 1. THE RELATIONSHIP OF THE VALUE OF THE MARGINAL PRODUCT TO ADDED COST WITH EGGS PRICED AT 30 CENTS AND 50 CENTS PER DOZEN FOR VARYING LEVELS OF CROWDING

Hens per 100 square feet of floor space	Total egg production	Marginal product[a]	Value of marginal product 30¢/doz.	Value of marginal product 50¢/doz.	Added cost[b]
28	5726	193	$4.82	$8.05	$4.73
29	5914	186	4.65	7.75	4.73
30	6099	179	4.47	7.46	4.73
31	6275	173	4.32	7.21	4.73
32	6445	166	4.15	6.92	4.73
33	6608	160	4.00	6.67	4.73
34	6764	153	3.82	6.38	4.73
35	6914	147	3.67	6.13	4.73
36	7058	140	3.50	5.84	4.73
37	7195	134	3.35	5.59	4.73
38	7325	127	3.17	5.30	4.73
39	7449	120	3.00	5.00	4.73
40	7566	114	2.85	4.75	4.73
41	7676	107	2.67	4.46	4.73
42	7780	101	2.52	4.21	4.73

[a] The marginal products were estimated from the equation and hence are an estimate for the number of hens indicated and not an average of the marginal product between two points as would be the case if they were calculated directly from the total egg production column given in the table.

[b] Calculated on the basis of 4¢ per pound of feet. Mortality charged at the rate of $1.25 per hen died or approximately $.32 per hen housed.

table indicates that the most profitable level of crowding would shift from 28 to 40 birds as the price of eggs changed from 30 to 50¢ per dozen with the price of feed remaining unchanged. While this is a somewhat exaggerated shift in cost-price ratios, fairly sharp changes do occur. For example, the average egg-feed ratio in Iowa changed from 13.6 to 9.6 from 1949 to 1950 and as a result the optimum number of birds per 100 square feet of floor space (under conditions duplicating those in the study) shifted from 41 to 36. By attaching different prices to the basic physical input-output data, the optimum level of crowding under any range of cost-price relationships likely to be relevant can be computed (Table 2).

While the recommendation of 33 birds per 100 feet of floor space for the light breeds commonly made by the poultry specialist does not appear to be in conflict with the results of this analysis, recommendations given

TABLE 2. THE MOST PROFITABLE NUMBER OF HENS PER 100 SQUARE FEET OF HOUSING SPACE WITH EGGS AND FEED AT VARIOUS PRICES[a]

Price of eggs	Price of one pound of poultry ration							
	$.025	$.0275	$.03	$.0325	$.035	$.0375	$.04	$.0425
cents	Number of hens per 100 square feet of floor space							
25	35	33	31	29	27	25	23	21
30	39	37	36	34	32	31	29	27
35	41	40	38	37	36	34	33	31
40	43	42	41	40	38	37	36	34
45	45	44	43	42	40	39	38	37
50	46	45	44	43	42	41	40	39
55	47	46	45	45	44	43	42	41

[a] The mortality component of added cost in the table was calculated at the rate of $1.25 per bird that died. To be strictly accurate the table would have to be expanded to include the cost of mortality as third variable.

in terms of a single "level of crowding," ought to be recognized for what they are—highly oversimplified approximations.[5] Many of the more alert farm managers "on their own" recognize the economics involved and make attempts to adjust the level of crowding to changing cost-price relationships. This is one of the many situations in which the application of the appropriate economic tools would enable the experiment station to refine its recommendations and give the most responsive and capable managers a firmer basis for making a decision.

RAYMOND R. BENEKE

Iowa State College

[5] Some poultry specialists justify a single conservative level on the basis that there is a widespread tendency on the part of the farmer to overcrowd the laying house. There is evidence suggesting that some poultry producers actually push into the range of diminishing total output. While this point was beyond the range of data available for this study, if one is willing to assume that the marginal physical product would continue to decline at the same rate beyond the range of the data, an estimate of it is possible from the regression equation fitted to the data. Since total output is at a maximum at that level of crowding where the MPP is equal to zero, estimating it involves setting the marginal physical product equation equal to zero and solving for X. Thus: $376.28 - 6.56X = 0$ and $X = 57.3$, the number of birds per 100 feet floor space at which total egg production is maximized.

SOME WEAKNESSES IN THE USE OF IMPUTED VALUES FOR UNPAID FAMILY LABOR AND FAMILY LIVING ALLOWANCE IN DETERMINING PAYMENT CAPACITY

THE necessity for imputing values for certain factors in formulating farm budgets has long been recognized. This is especially true with regard to determination of repayment capacity in land reclamation. The

use of forward prices, although subject to many limitations, is now considered indispensable in budget design. Proposed farm organizations are necessarily based both upon adaptations to known physical conditions and upon estimates of probable market and labor conditions. Yet, of all the factors requiring imputed values, unpaid family labor and family living allowance appear to be subject to the greatest gap between existing and effective treatment. It is with these two factors that this paper will be concerned.

Unpaid Family Labor

Allowances for unpaid family labor in budget design are usually based upon average amounts of labor supplied by farm families as determined from surveys or analyses of farm accounts. Such procedure is warranted in the analysis of actual farm accounts, but the use of unpaid family labor in budget design should be seriously reconsidered. Failure in budget formulation to charge the farm business for labor provided by the farm family may result in an over estimate of ability to pay by an amount equal to the cost of labor which must be hired in lieu of unpaid family labor.

For purposes of illustration, consider proposed reclamation project "A" in which the most typical farm is expected to be a 100 acre, 20-cow, grade A dairy. Assume that a given survey indicates that for farms of this description the average number of work units required is 450 and that of this total an estimated 290 work units are supplied by the operator; 50, by hired labor; and 110, by unpaid family labor.[1] Further assume that the financial summary indicates net family farm earnings of $3,500.[2] Subtracting a family living allowance of $2,400 from net farm earnings leaves $1,100 per farm, or $11 per acre which would generally be considered the payment capacity for irrigation construction, operation, and maintenance costs.

The use of such a budget has at least two fundamental weaknesses insofar as the treatment of family labor is concerned: (1) it makes the capacity to repay dependent upon an average use of unpaid family labor thus concealing the actual payment capacity of the farm as a business unit and (2) it ignores the dynamics of farm labor arrangements characteristic of farms in a free enterprise economy.

In this hypothetical case, the average amount of work supplied by family labor, other than that of the operator, has been estimated at 110 work units. Yet in reality there would be instances in which this is ex-

[1] A work unit as used in this illustration refers to the amount of work which can be accomplished by a typical farm worker in a normal working day.

[2] Net family farm earnings is considered to be gross farm income (including farm privileges) minus all farm expenses (including a charge for interest on capital investment, but no charge for unpaid family labor).

ceeded and others in which no family labor would be available. In the latter case, the operator may be a young farmer with no children or with children too young to work on the farm; or perhaps a middle-aged farmer whose sons have left the farm. In each case where there is no unpaid family labor the farmer would find it necessary to hire 110 additional work units of labor. With an expected wage rate of 55 cents per hour during the repayment period, the annual cost of hiring additional labor in lieu of family help would be $605. Subtracting this from net family farm earnings of $1,100 leaves a payment capacity of only $495 per farm, or $4.95 per acre.

If farmers on project "A" were to be assessed on the basis of ability to pay as determined from typical budgets, those having less than an average amount of unpaid family labor, other factors being the same, would be unable to meet the assessments for reclamation development. In fact, with no unpaid family labor available, a farmer on project "A" would fall $6.05 per acre short of being able to meet annual water assessments.

As to the dynamics of farm labor arrangements, the use of a specified amount of family labor in budget design fails to take into consideration the fact that labor arrangements on most farms are constantly changing. A young farmer with no unpaid family labor will have to hire all work done which he cannot do himself. Yet in a few years he may have sons and possibly daughters who are willing to help on the farm. But in a few more years the children may all leave the farm and the farmer will again find it necessary to hire help. There are many possible ramifications.

Family Living Allowance

An average allowance in budget design for family living costs is subject to some of the same limitations as the allocation of a certain amount of work to unpaid family labor. The amount of money expended for family living under actual conditions would be expected to vary with size of family, health of family, opportunities for off-farm employment and a number of other environmental factors. However, there is one basic difference between the two allocations. In the case of unpaid family labor it is possible to abate the problem by making a charge for all labor other than that of the operator. But as long as repayment capacity is determined from the income residue after allowance for all costs, an estimate must be made for family living allowance. It might be rationalized that living costs would be generally higher for the larger families and that the higher aggregate cost would in many cases be offset by the associated greater amount of unpaid family labor. But here again there would be many exceptions.

Although the writer has no definite solution to this problem, it would

seem that in order to permit all farmers to meet repayment costs that an allowance for family living somewhat above the average would be essential.

Summary and Conclusions

Where reclamation development is justified on the basis of an assumed amount of unpaid family labor and the farmer has an average or above average supply of unpaid family labor, he will, other conditions being the same, meet his reclamation costs; if not, he may find water costs beyond his ability to pay. On the other hand, if payment capacity is based on budgets where all labor costs are taken into consideration, all farms should be paying farms, other factors being the same. The man with the working family would have a distinct advantage due to his free labor.

Likewise, where reclamation development is justified on the basis of average aggregate living costs per family and the farmer has an average family and typical environmental conditions, he should be able to meet his reclamation costs, other conditions being the same. But where his living costs are unavoidably higher because his conditions are not average, he may not be able to meet his payments and still maintain an adequate standard of living. Thus it would seem essential for the success of a project that the allowance for family living in budget design be somewhat in excess of the average.[3]

F. S. SCOTT, JR.

University of Nevada

[3] This recommendation does not coincide with the contingency allowance often used in budget design, but would be in addition to the effect of the contingency.

COMMENT ON "ECONOMIC NATURE OF THE COOPERATIVE ASSOCIATION"

IN THE February 1953 issue of *This Journal,* Richard Phillips presented a challenging theory as to the nature of cooperative associations.[1] His treatment is based on the orthodox theory of the firm as a profit-maximizing enterprise. However, the firm which he speaks of is the household, and he denies that a cooperative association composed of firms or households can have economic life or purpose apart from participating economic units. His conclusion is somewhat startling when it ignores the existence of the cooperative as a going economic concern, especially as I think most farmers and most cooperative leaders do not share his view.

[1] Richard Phillips, "Economic Nature of the Cooperative Association" *This Journal* No. I. pp. 74-87, Feb. 1953.

Also Phillips draws some debatable conclusions on control on the basis of proportionality, and profit maximization versus stability. The discussion which follows is a critical examination of the Phillips thesis and the conclusions which are deduced.

The Problem and Solution as Viewed by Phillips

Phillips has presented an excellent treatment of the economic nature of cooperatives based on the classical analysis of the firm. True to tradition his problem turns out to be how to allocate the inputs so as to obtain the maximum output. The allocation problem arises because of the scarcity of the means and the diversity of the competing ends. Having determined that the problem is resource allocation the solution is evident. It is to remove any obstacles in the way of optimum allocation. The best way to remove these obstacles is to allow the self interest of the individual firms free play and in the long run an equilibrium will be reached in which all resources will be allocated at the optimum. For Phillips the equilibrium position is the goal to be achieved. In order to fairly evaluate Dr. Phillips' contribution as to the economic nature of the cooperative through the use of the classical theory of the firm I think it well to critically examine the structure upon which most of this theory rests.

Nature of Phillips' Model

The economic model which Phillips uses dates back to the Physiocrats and Adam Smith. The Physiocrats assumed that the economic system was based on a natural order ordained by God. Adam Smith also believed in a natural order, but an order to which man subjected himself because it was in his best interest to do so. Adam Smith and the Physiocrats visualized a society of atomistic individuals all acting in their own selfish interest. They further assumed that what was best for the individual was also best for economic society as a whole. Smith and the Physiocrats viewed the economic problem largely as production, involving the proper allocation of resources, and its solution was to allow each individual to act in his own self interest. The famous policy of *laissez faire* was the result of this philosophical approach.

Built upon this structure is the competitive model in which it is assumed that (1) perfect knowledge exists, (2) perfect mobility of factors of production and the competing units are so small that individual decisions have no effect on each other.[2] The classical theory assumes that in the long run an equilibrium position will be reached in which all resources will be allocated at their optimum output. In brief this is the model which Phillips applies in explaining the economic nature of cooperatives. Implicit in this

[2] Imperfect competition is assumed in the market in Phillips' model.

model is the assumption that the individual must adjust to his economic environment rather than being able to adjust his environment.

Major Criticisms

I do not question the usefulness of the orthodox competitive model as a tool of scientific economic analysis, but I do question the use which Phillips makes of it in explaining the economic nature of cooperatives. I shall endeavor to show that his use of this model as a goal rather than as a tool has led him up some blind alleys with respect to the nature of cooperatives. He has in effect accepted the vision of Smith and the Physiocrats on the nature of economic society when he accepts their solution.

Farmers as well as others are now organized into groups, and their economic nature can not be adequately explained by a theory which rests solely on a premise of individualistic competition. I also contend that in accepting this model as a goal Phillips has relegated the cooperative to the same pessimistic position as that of the classical economists, particularly Malthus and Ricardo, who were mainly responsible for developing the thesis that resources are fixed and scarce, and that therefore man has to accept his environment. A major reason for the cooperative institution is that individuals have realized that they can do more than adjust to their environment. They can influence and change the economic society in which they as cooperative members live and carry on business transactions. Cooperatives are proof in themselves that man can help make his environment.

The Cooperative is a Firm

In making the transition from the individual firms to the cooperative, Phillips says that there are no entrepreneurial decisions made at the cooperative level. This he deduces from the fact that the individual firms own the joint plant and in the traditional firm postulated by the classical economist ownership and functional control are one. A casual analysis of practically any cooperative today would show that though farmers own their cooperatives and control them in the broad sense of the word they do not make all or most of the entrepreneurial decisions. Again it is slavishness to a model which leads Phillips into this error. This occurs because of his definition of the entrepreneurial function as being that of directing the allocation of the factors of production for profit of the entrepreneur. Since the cooperative does not operate for profits for itself Phillips believes that it is not a firm in itself and is therefore not capable of entrepreneurial decisions. This theory says a firm is not a firm unless it seeks profits for itself. It denies that a cooperative is a going concern; a serious charge that does not appear to coincide with reality. Most of all

the theory points up the need for broader interpretation of the definition of a firm in accord with actualities.

Against Phillips assertion, I look upon a cooperative as a firm in itself capable of making entrepreneurial decisions just as any private corporation. It is a "going concern," and a "going concern" has been defined as "an organization of coordinated activity; it is collective behavior with a common purpose, and a collective will governed by common working rules."[3] The individual farmers have pooled certain of their entrepreneurial functions and in so doing they authorized a collective body to perform these functions for them. In the process the farmer creates an agency and defers to it some of his individual prerogatives in order to obtain greater advantages.

In some ways a cooperative is like the State. It seeks no profit for itself, but for its citizens. Citizens give up certain individual freedoms in order to gain the greater ones afforded by the State. Few would deny that properly elected and appointed officials have the right and the legal power to carry on the functions of government, functions which are actually the pooled wills of its individual citizens. The State is organized to enforce the common will concerning certain phases of human conduct; whereas cooperatives are organized to carry out the common will of select groups dealing with the economic phases of human conduct, and correct analysis of their composition and purpose will not deny them the power to exercise the will delegated to them by their individual members.

If the right to carry out collective will is denied the association then the essence of cooperation is lost. The sum total of its actions will no longer be greater than the total of the individual member's actions. Therefore, I do not think the theory of the firm as used by Phillips adequate. A sound theory is sound in practice, and if we look at cooperatives about us today we can see them as "going concerns" performing entrepreneurial functions delegated to them by members.

Farmers seem to look upon the cooperative firm as their agent in certain matters affecting their individual profit-seeking efforts. In a sense some of the entrepreneurial decisions are considered as being hired much as they are in a private corporation such as General Motors. The main difference lies in the relatively greater power which members of a cooperative have to influence the collective will of their organization, and there are many case histories to prove that this right has been used. Anyone familiar with farmer associations can name a dozen or more cases where the members even though they don't act as individuals have fired their managers, replaced the board of directors or forced other changes. This

[3] Kenneth H. Parsons, "John R. Commons' Point of View," *Journal of Land and Public Utility Economics*, Vol. VIII, No. 3. Aug. 1942. p. 254.

is entrepreneurial action, but it is only exercised during extreme conditions. Outside of such brief interludes the membership is content to delegate a part of its profit-making functions to the cooperative firm.

Voting on Basis of Proportionality

Another interesting conclusion to which the theory of firm appears to lead Phillips is that voting on the running of the cooperative should be on a proportional basis rather than a "one-man-one-vote" basis. This is a grave attack on a principle which has come to be accepted by most cooperatives in this country—the "one-man-one-vote" principle.

Again strict adherence to formalistic economics has obscured the facts. The purely competitive model demands that each individual be allowed to act without restraint in his own selfish interest. It follows from this that the entrepreneurial decision of a farmer owning 1000 acres of land would likely be different on occasion from that of a farmer owning 100 acres, and if each is given one vote only in a joint economic decision one or the other will not be able to act in his own selfish interest.

I think the decision by the cooperative group as to whether they will have voting on the basis of proportional production or on a "one-man-one-vote" will depend on facts with which the classical model is not equipped to deal. This decision will be influenced by ethical and social reasons as much as by economic considerations.

Profit Maximization Vs. Stability

When Phillips discards the static conditions of the classical equilibrium position for dynamic conditions, he concludes that farmers are interested in maximum stability as well as maximum profits. He assumes that maximum profits and maximum stability conditions compete for the farmers' resources. By means of indifference curve diagrammatics he shows how the farmer can allocate all of his resources toward profit maximization or all toward a stability position, or he can allocate his resources so as to equate his expected profit and stability positions.

I agree with Phillips that farmers are motivated by these two considerations, but the theory of the firm is not equipped to deal with the problem once the assumption of profit maximization as the regulator is dropped. What is to take the place of this regulator? If stability as a regulator or part regulator is introduced then the scope of the problem must be increased to include facts which most orthodox economists would preclude. The firm might decide, for example, that it would be wise to sell their products at less than the full price which could be obtained at the time. This decision might be made for any number of reasons—custom, ethics, social considerations, or for purely stability reasons. The important point

is that once profit maximization assumptions are dropped the orthodox machinery ceases to work because the motor (profit maximization) is shut off.

In my opinion Phillips begins to get on solid ground when he assumes that farmers are interested in maximum profits along with maximum stability. This position pursued in a logical manner would lead him to use the orthodox model as a tool rather than a goal. In this manner he would come to treat those parts which fall outside the model properly. Undoubtedly there are economic problems in which the parts excluded are irrelevant or inconsequential, but this can be determined only after careful examination of the situation. They should never be simply assumed away before they are studied.

In Phillip's final paragraph he concludes that "an understanding of the economic nature of cooperative business, as developed here, clearly reveals the absence of scientific basis for such statements as 'in the cooperative association people, not capital, count, factors are free to cooperative members, cooperation is superior way of doing business,' to the extent that the cooperative is different from other types of business activity, it is a social organization; and in business, cooperation is the antithesis of competition."

These statements of the bogey man variety are rather meaningless when listed out of context as above. Of more importance is the implication that the theory of the firm is the only scientific basis for economics. Economic Science is at its best when it considers the strategic factors in any situation. The fact that cooperation is viewed by its patrons as a superior way of doing business is very important. The fact that members look upon the cooperative as an association of people and not capital is also important. The weakness of the theory of the firm is clearly exposed here when Phillips virtually admits these strategic factors are outside of the alleged scientific theory.

When Phillips refers to "business with members at market prices" and "business on a strictly cash basis" as cooperative principles, he is defining as principles those which are today generally considered as two operating practices. This confusion may be overlooked, but describing the "one-man-one-vote" principle as inaccurate or irrelevant because the theory of the firm is not able to cope with it ignores the basic facts that most cooperatives adhere to this democratic principle. Theory which abandons fact because it does not fit a mathematical mold has a weakness. This weakness can be disastrous when the theory is applied indiscriminately.

JOB K. SAVAGE

Farmer Cooperative Service, U.S.D.A.

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BOOK REVIEWS

Demand Analysis, A Study in Econometrics, Herman Wold in association with Lars Juréen, New York: John Wiley and Sons, 1953. Pp. xvi, 358. $7.00.

This important contribution to the literature of empirical demand analysis can be studied to advantage both by specialists in this field and by economic statisticians generally. It consists of a report on extensive analyses of Swedish data related to demand for various foods combined with an exposition of some basic topics in the underlying economic and statistical theory. Professor Wold has written the theoretical and methodological sections; Mr. Juréen of the State Agricultural Marketing Board of Sweden and Professor Wold have jointly reported their empirical work. The book has many merits. The exposition is skillful, difficult passages being associated almost exclusively with inherently difficult topics. A few repetitions of key equations and tables would save the reader considerable turning back, but this is a minor matter. There is much evidence that the data were handled with care and understanding, and the interpretations of results are interesting and, for the most part, seem reasonable. Further evaluation of this aspect of the work may properly be left to reviewers with better knowledge of the Swedish economy. While the author warns that the bibliography is not comprehensive, it is certainly extensive enough to be very helpful.

The discussions of consumer demand theory and of stationary random processes should prove quite useful. The former brings together a variety of previously scattered ideas. The latter provides an elementary discussion of some basic results in a little-known field and gives some notions of how these may be brought to bear on methodological problems. However, one may wish that the connections between some of the theoretical results and the conduct of the empirical analyses could have been made more explicit. For example, the rationalization of single equation least squares procedures that is offered depends very much on the contention that market situations can generally be satisfactorily represented by recursive systems of equations. It would have been useful for the authors to have attempted to construct specific recursive systems appropriate to the particular markets that they investigated.

Familiar least-squares procedures have been used throughout, sometimes with a previous estimate of one coefficient being inserted before other coefficients are estimated as in some of Tobin's work.[1] In our present state of uncertainty about the proper statistical formulations for various economic investigations, one cannot say that least-squares procedures are

[1] James A. Tobin, "A Statistical Demand Function for Food in the U. S. A.," *Journal of the Royal Statistical Society* (A) 113, 113-141.

wrong or that they are definitely inferior to other procedures that might be suggested. Yet it does seem to this reviewer that Professor Wold has become more firmly convinced of the appropriateness of his procedures than his present arguments warrant.

As noted earlier, a major argument is the suitability of recursive systems. In Chapter 12 (p. 203), a possibility theorem for recursive systems from sets of stationary time series is given. Granting the proof (I cannot claim to have verified it), a question that naturally arises is whether or not the individual equations of such a recursive system can be associated with the equations that economists use in their theoretical reasoning. In most cases this means associating equations of the system with the behavior of identifiable groups such as consuming households, producing firms, processing firms, etc., in a market analysis or consumers, investors, banks, etc., in a macro-economic study. Wold indicates the importance of such associations in Chapter III (e.g. pp. 66, 67), but does not seem to realize that this desideratum may often be in conflict with his desire to make each equation express a unilateral causal dependence.

Wold argues that the demand relations he studies each express a unilateral dependence of quantity upon price and sometimes other variables. He notes that a consumer entering the store finds price already set (see p. 10) and thus only infiuences quantity exchanged. Thus he argues, in effect, that supply may be treated as infinitely elastic and that price is determined independently of the demand relation. If we were concerned with daily variations in price and quantity, it would be possible to attach considerable weight to such an argument. However, when we are concerned mainly with annual variations, it is hard to imagine that the annual average price which we observe has not been strongly influenced by the rates at which goods have moved at the various daily prices tentatively established, i.e., that for periods as long as a year, the demand relation affects both quantity and price and does not express a unilateral dependence. Other arguments by Wold on the appropriateness of least-squares are likewise open to some question. The greater flexibility claimed in the Preface is difficult to accept in view of the fact that a single equation model which leads to familiar least-squares procedures is really a special case of more general simultaneous equations models and thus cannot have a larger domain of empirical application. It is of some interest to note that others who have applied least-squares methods to demand analysis have often argued for price as the dependent variable even though Wold's arguments for quantity would apply equally well to the markets they have studied.[2]

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[2] See, for example, Karl A. Fox, "The analysis of Demand for Farm Products", Technical Bulletin No. 1081, United States Department of Agriculture, Washington, D. C., 1953.

Other aspects of the methodological discussions contain some weaknesses which might be briefly noted. Successful prediction is properly stressed as the final criterion for useful models and methods, yet no standards for deciding what are good predictions are suggested.

There seems to be an error in the comparison of market and budget elasticities on p. 230. μ^* is not explicitly defined but if it is associated with average income from market statistics (as is suggested by the definition of E^*), then we have $\frac{\Delta\mu^*}{\Delta\mu} = \frac{\mu b + \mu n}{\mu b}$ rather than its reciprocal as given by Wold.[3] Thus the allocation of some expenditures to new commodities will tend to make income elasticities derived from budget data greater than income elasticities derived from market data. This result should certainly be applied with caution since new uses for old commodities may be fully as important as new commodities in a given period and new commodities may be either complements or substitutes of an existing commodity.

With respect to problems of auto-correlation in disturbances of economic relations, the author neglects possibilities for eliminating auto-correlation through reconstruction of the model.[4] Problems of aggregation, trends and real vs. monetary units are treated rather cursorily with no significant additions to previous discussions. However, a single book cannot be original in everything and this should be regarded as a casual observation rather than an adverse criticism.

For the most part, the criticisms offered here are symptoms of the uncertainties and controversies that continue to attach to empirical investigations in Economics. They do not prevent the work from being an important and useful one, but they do mean that a student of the subject should also seek references in which opposed points of view are more fully developed.

CLIFFORD HILDRETH

North Carolina State College

[3] A factor $(\frac{\mu}{q})$ has been omitted from the left side of the first equations on line 17 but does not affect the argument.

[4] For an example see A. W. Marshall and J. Hirshleifer, "The Supply of Female Labor in World War II" mimeographed paper P-420 of the Rand Corporation, Santa Monica, California, 1954.

Principles of Farm Management, J. Norman Efferson, New York: McGraw-Hill Book Co. Inc., 1953. Pp. vii, 431. $6.00.

The organization of this text is unusual for a first-year course in farm management. Chapters 2-4 are devoted to a statement of the author's philosophy concerning the need for data, the methods of collecting and of analyzing data, and the place of economic theory in farm management.

Financial records discussed in Chapters 5-7 are followed by ten chapters devoted to factors affecting farm earnings. Organizing and operating the farm business is the subject of Chapter 18, which takes up 20 pages, and in which farm plans are mentioned for the first and last time. Chapters on finances and farm business arrangements conclude the book.

The setting for farm management analysis provided in the first four chapters will not appeal to some readers. In the author's opinion, "The three things which form the essentials of science . . . are scientific approach, scientific knowledge, and scientific law. . . . If the approach has been impartial, careful, and thorough, if the facts have been assembled in the proper perspective, and if the laws have been accurately developed from these facts, then the scientific laws so obtained will apply at any time thereafter to a similar set of circumstances" (p. 26). Social scientists have waged a lengthy battle against this type of confusion in their attempts to gain acceptance of the view that science is a method or methods of inquiry rather than a body of laws.

Farm management data can be collected from farm accounts, farm surveys, experimental farms, and theoretical farm models. The latter, the author feels, is of little value, since "a given farm has a group of problems that are both physical and economic in character and are not subject to an analysis which is purely economic in character" (p. 43). It is precisely this combination of physical and economic considerations that frequently makes it desirable and often imperative to use techniques which do not require that conditions remain unchanged in order to guide farmer decisions. Most important in determining the source, perhaps, is the nature of the data required to answer a given question.

Analysis of farm management data is possible through "(1) the method of direct comparison, (2) the method of budget analysis, (3) the case-study method, (4) the multiple-correlation method, and (5) the economic theory or theoretical approach" (p. 59). The author views economic theory as an (inferior) alternative to direct comparison, budget analysis, and case studies, rather than as an aid in formulating the question to be asked, in determining the data needed, and in testing alternative courses of action. One gets the impression that statistics is likewise considered an alternative method rather than a set of tools that is generally useful in analyzing data from a variety of sources.

The author states in the Preface his intention to emphasize principles rather than to present a collection of facts. This is done by excluding from the text input-output and price-cost data in any form.

Except for a brief discussion in Chapter 3, there is little emphasis on how principles can be used by farmers in choosing among alternative courses of action.

North Carolina State College RICHARD A. KING

The Frontiers of Economic Knowledge, Arthur F. Burns, National Bureau of Economic Research. Princeton: Princeton University Press, 1954, Pp. ix, 367. $5.00.

Why was this collection of essays by Arthur F. Burns published? I can imagine some bookman seeing a market opportunity here since Mr. Burns is now the Chairman of the Council of Economic Advisors. The publisher's blurb inside the dust cover indicates this may be so. However this is not primarily about Mr. Burns. It is a book about the National Bureau of Economic Research and its work and about its long time director, Wesley Mitchell. As such this book enables the National Bureau to toot its own horn, and it reveals Mr. Burns as an able maestro.

This points up the major criticism of this work. It has no clearcut purpose. Therefore it is difficult to measure its accomplishments. The reader has no idea why these essays were selected. It is not apparent even who made the selections.

Nonetheless there are a lot of useful information and many stimulating ideas tucked inside these pages. The first eight essays are reports on the National Bureau's work from 1946 through 1953. They help place in perspective the voluminous work of the National Bureau in the field of economic activity. With other essays they make up a good survey of contemporary economics on business cycles *a la* the National Bureau approach. Also for the agricultural economist or the graduate student facing prelims, there is a good critique of Keynes in these pages.

By picking and choosing the reader can learn something about Mr. Burns also. Evidently he is stimulated into writing essays primarily in response to other writings. Only one of the sixteen essays is not written as a review, an introduction, or a report on the work of others. Mr. Burns is revealed as being un-Keynesian rather than anti-Keynesian in his approach. He deals rather abruptly and sharply with the "hot" Keynesians as represented by Alvin Hansen in the essay which has been one of my favorites since its appearance in 1947.

Contrary to certain opinions about the methods of the National Bureau, Mr. Burns is not anti-theoretical. But theory must be realistic and not speculative. "When all is said and done, there is no methodological problem in economics other than straight thinking and the competent use of evidence" (p. 227).

Two of the most important issues in the years ahead are the role of government with respect to private enterprise (p. 143) and "the prevention of severe depressions, not of business or employment cycles" (p. 132). His discussion of these two issues sheds some light on the recommendations that may be forthcoming from the Council of Economic Advisors.

Those people who are not previously familiar with the work of the National Bureau of Economic Research, Wesley Mitchell, and Arthur

F. Burns will learn something from these essays. To the person not previously acquainted with Mr. Burns and interested in him because of his new job, these essays will serve to convey the impression that the Council of Economic Advisors is in pretty good hands.

Perhaps the title expresses the area of the book most succinctly. The frontiers of economic knowledge are in the broad field of cycles—the headquarters of the frontier are located in New York City at the National Bureau. Is there anyone who disagrees?

ROBERT L. CLODIUS

University of Wisconsin

Principles of Appraisal, Giuseppe Medici, Ames: The Iowa State College Press, 1953. Pp. xi, 254. $3.50.

The author of this book, Giuseppe Medici, is Head, Department of Appraisal, University of Naples, and President, National Institute of Agricultural Economics, Rome. The book contains a foreword by W. G. Murray, Head, Department of Economics and Sociology, Iowa State College.

Published in Italy in 1953 under the title, *Principii di Estimo,* the Italian edition was so widely read and generally acclaimed that arrangements were made to bring out this smaller edition for the English-speaking world. It will be appreciated by students of appraisal who like to go into the theoretical background for their field of study. However, this book is not all theory, since there are interwoven with the theory many practical applications.

The text is divided into two parts: Book I, which deals with *general appraisal* or *the appraisal method,* and Book II, *special appraisal.*

In the first two chapters the author discusses appraisal judgment and the appraisal method. In these chapters is introduced the idea of five diverse values of the same object and the conditions under which they tend to coincide or to differ. Although appraisal covers the relations which exist between the practical reasons for the appraisal and the valuation of the property, this, according to Medici, must not lead us to commit the error of considering that it is because of the diversity of these reasons that one and the same object can have several values at the same time. Rather, it is because of disequilibrium, or imperfect competition. The five economic aspects of an object of wealth which are considered are: market value, which coincides with capitalization value; cost of reproduction; transformation value; substitution value; and complementary value. These aspects are developed in detail in Chapter III.

The method of appraisal is considered to be basically a process of logic. It consists of "the forming of a scale of prices and the selecting of a level

of the scale at which to place the object to be appraised." The final step is to deliver the judgment of value. This step, according to Medici, "is creative and consequently cannot be completely analyzed, nor can it be taught."

There are considered three principal approaches to the problem of valuation, particularly as relating to the appraisal of real estate. These approaches are the *synthetic, analytical* and *comparative.* The greater part of Book I, following the opening introductory chapters, is devoted to the analytical approach. This approach is essentially the process of capitalization. The usual formula, $V = \frac{Rv}{r}$, is based on three hypotheses—"the market value tends to be equal to the sum of the future incomes discounted at their present value"—"it is possible to estimate these future incomes and their respective rates of discount"—and, "it is possible to ascertain the rental value with the approximate accuracy pertaining to an appraisal." Chapters V and VII are then devoted to the problems of the determination of rental value and the rate of capitalization.

Although the book was written in an obvious attempt to make each chapter stand on its own feet and be complete in its own right, one can but wonder why Chapter VI, which deals with the appraisal of lands planted to fruit trees and bushes, was placed between Chapter V, which deals with rental value, and Chapter VII, which deals with capitalization rates, rather than in Book II which deals with special appraisal. Aside from this apparently misplaced, though excellent, chapter, a logical sequence runs throughout Book I.

The synthetic and comparative approaches to valuation are dealt with in Chapter VIII. In this discussion the author draws heavily upon German writers on the subject, quoting freely from Aereboe, Von der Goltz and others. These approaches comprise various methods, all of which have to do with the collection of data on the sales prices of comparable farms in the area. These approaches become particularly complicated in Europe, since land is so seldom for sale that it is difficult to establish levels of selling prices. Medici emphasizes this point by quoting from Einaudi: " 'Land for sale does not appear on the market until one or other of . . . events . . . occurs: economic convulsions, as in postwar years; the ruin of a peasant family due to idleness; or, in the case of gentry, gambling, bad behavior or slow exhaustion and financial difficulties long disguised by the creation of debt. Apart from such circumstances, the axiom governing the normal economic conduct of a land-owner is that land is *not* for sale. This is not an economic axiom; it is born of instinct and is incomprehensible to the townsman. Those in whom that instinct works buy but do not sell. To sell is an illicit, immoral action which their moral code forbids.' "

In Book II, which deals with special appraisal, are chapters devoted to the appraisal of land improvements, the repartition of land-reclamation contributions, the appraisal of water for irrigation and the appraisal of forage crops.

Although theory is stressed throughout the book, there are many practical applications. There are numerous mathematical formulas, but they are so deftly handled that they could not be considered burdensome to those with only moderate training in mathematics. Numerous Italian words and expressions are included due to difficulty of translation. This does not seem to be sufficient justification, however, for the considerable number of misspelled words found throughout the text. This book will doubtless find a ready place as collateral reading for courses in farm appraising in this country, but will hardly replace our standard American texts for classroom work.

MARVIN A. BROOKER

University of Florida

George N. Peek and the Fight for Farm Parity, Gilbert C. Fite, Norman: University of Oklahoma Press, 1954. Pp. xiii, 314. $4.00.

George N. Peek, a rising newcomer to the farm movement in the 1920's, was a leader in the fight for agricultural programs in the decade when farm price programs failed to become law. Later, after serving as the first Administrator of the AAA, he fought just as vigorously against agricultural policies established by the New Deal.

Agricultural economists and others interested in the politics of agriculture will probably place this book high on their reading lists because it is a dramatic, absorbing and factually accurate account of the parity battle, even though it illustrates how an author's interpretations can be influenced —very subtly indeed—by what this reviewer considers a highly questionable postulate or proposition, namely: Since George N. Peek led and directed the early battle for a farm price support program based on parity "farmers who enjoy parity or near-parity prices owe George Peek their undying gratitude." Whether the passage of farm price-support legislation in the period since 1933 would not have occurred without Peek's battle is something of a moot point. Whether or not the overall terms of trade for agriculture have generally been much improved by parity price-supports is probably another.

George N. Peek is shown to be a stubborn and forceful man with a program that he was convinced would win income equality for agriculture. Born on an Illinois farm in 1873 he had in the years before World War I proved himself to be an able and aggressive executive, a highly successful salesman and an acknowledged leader of men. He rose to the

vice-presidency of John Deere and Company. He served with distinction on the War Industries Board in World War I. He became President of the Moline Plow Company. Through investments in this company and others he soon attained a modest fortune, sufficient to make him independent of salary or personal position. The drop in farm prices in the early 1920's, resulting in considerable loss to farm machinery dealers, as well as hardship to farmers, brought the plight of an overexpanded agriculture forcefully to his attention.

He made a two-price plan for major exportable farm products behind an impregnable tariff wall the keystone of his farm policy. He thought that by exporting the "surplus" with the aid of an equalization fee, farm prices could be raised in the domestic market to an "equality" (as expressed in pre-war ratios) with prices of other commodities. "Equality for Agriculture," the little pamphlet written in 1922 with General Hugh S. Johnson, outlined his program, and further committed him to battle. Throughout the 1920's and most of the 1930's he fought, organized and campaigned—often at considerable personal sacrifice—for this program. He would not embrace a substitute. When President Coolidge twice vetoed the McNary-Haugen bills, Peek bolted the Republican Party and tried to swing the farm vote to the Democrats in 1928 and 1932.

Named Administrator of the AAA, he soon was at odds with Secretary Wallace, Undersecretary Wilson and others who recommended acreage controls and other devices to regulate production as the best means of achieving relief for agriculture in the depressed conditions of the 1930's. By this time Peek had come to favor marketing agreements plus benefit payments sufficient to bring farm returns to parity, in addition to an agressive program to expand exports. Then as always, however, he considered production restriction only as a last resort. Forced to resign as Administrator, just seven months after taking office, he was appointed the President's Special Adviser on Foreign Trade. But Peek, a high-tariff isolationist who conceived of trade as barter, viewed with abhorrence the objectives of the Reciprocal Trade Agreements Act in which Secretary Hull so firmly believed.

Forced to resign as Special Adviser, Peek became one of the New Deal's bitterest and most vocal critics. (His book *Why Quit Our Own* published in 1936 is a sweeping indictment of the Roosevelt farm and trade policies. The Chemical Foundation, Inc., of New York, interested in having high tariffs, bought 100,000 copies and distributed these to libraries and individuals throughout the country.) In 1941 he joined America First. Denying that he was an isolationist he spoke of "intelligent insulation." After the Japanese attack on Pearl Harbor he gave his full support to the war effort. But throughout 1942 and 1943 he stepped up his assault on every move-

ment that looked like American co-operation in the post-war world. At the time of his death he was working on a pamphlet entitled, "Alien Influences in America," and was hoping to help purge the Republican Party of the so-called internationalists in the 1944 election.

Thus closes the story of a man who started out at the center of a movement that he could not control and ended quite outside its orbit. The story deals with a fundamental issue in agricultural and trade policy. It provides insights into high levels of the political process.

The author, Associate Professor of History at the University of Oklahoma, drawing extensively on primary source material, brings together much information not previously published.

Although disagreeing with Peek's solution and not accepting a basic tenet of the author indicated above, the reviewer found Professor Fite's book to be an interesting and scholarly account of a dramatic period in the formulation of a national price program, well worth reading by those interested in the development of agricultural policy.

HAROLD G. HALCROW

University of Connecticut

Agricultural Finance, Third Edition, William G. Murray, Ames: Iowa State College Press, 1953. Pp. 419. $4.50.

This standard textbook dealing with the principles and practice of farm credit, first brought out in 1941, now makes its appearence as an improved third edition. While retaining essentially the same arrangement of contents as the previous edition, some definite improvements have been added.

In Part I dealing with "Principles of Farm Credit" the problems are approached from the standpoint of both the borrower and lender because, as the author states, both "are mutually interested and concerned." The opening chapter has been broadened to cover the title of "Nature and Significance of Agricultural Finance." Other major changes in the first part include the addition of a new chapter on "Risk, Insurance, and Investment." The chapter on "Natural Hazards and Loan Policy" has been rewritten to incorporate recent research results in this field.

The author is to be commended for the increased attention he has devoted to the subject of risk. The increasing emphasis given to this problem, particularly as exemplified by research in the Great Plains States, needs to be reflected in the classroom discussion of our agricultural colleges.

In Part II, the former chapter on commercial banks has been expanded to include one chapter on "Organization" and a second on "Operations."

The new chapter on operations incorporates an excellent discussion of loan procedure which will be found useful to both lenders and borrowers. Throughout Part II, discussion of changes in legislation affecting agricultural financing facilities has been introduced, including housing and disaster loans and the new legislation affecting the Farm Credit Administration.

To illustrate and amplify discussion throughout the book Murray has drawn liberally, but with good judgment, on the more recent research studies pertinent to the various segments of the field. The usefulness of the new edition for students in agricultural finance is materially enhanced by the introduction of up-to-date statistical data and charts. Teachers who have the responsibility of conducting courses in this field will appreciate the revised and enlarged series of questions and problems at the end of each chapter.

Aside from its broad coverage, the outstanding feature of this book arises from the manner in which it combines theory and practice. The principles governing farm investment, the use of credit, provision against risk, the operation of credit institutions, and other subjects are treated in simple language, with practical illustrations, so that they appear to be matters not of theory alone but also of ordinary, common-sense judgment. This derives from the author's long and extensive experience in agricultural finance, and from his faculty for clear and simple expression.

Both editions of this work have been revised with such care as to make available an up-to-date textbook. Each edition also represents a historical record of developments in agricultural finance since the previous one. In the opinion of this reviewer, Murray's treatise will continue to receive wide acceptance as a textbook in agricultural finance courses.

NORMAN J. WALL

U.S. Department of Agriculture

Milk Distribution and Pricing in Great Britain, Leland Spencer and Stewart Johnson, Ithaca: Cornell University Agricultural Experiment Station Bulletin 902, August 1953.

This bulletin, which, from its contents, might well be designated a book, is brimful of interesting material for students of marketing, in every one of its 147 pages. It is exceedingly well written, and, as would be expected from such authors, has a well laid out, logical construction, with a clear analysis and co-ordinated argument. The title, "Milk Distribution and Pricing in Great Britain" scarcely does justice to the value of its contents. The purpose of the study, as the authors state in the opening page, was to find out and assess the value of the experience in marketing in

other countries where, for various reasons, a marked measure of control or rationalization has been established in contrast to the comparatively unfettered and competitive system of marketing in the United States. Milk Marketing in Great Britain was chosen as the field of investigation, because of its close resemblance to the U. S. in its economic and social organization, as well as its similarity in language.

The authors did not limit their exploration, as less experienced researchers might have unwittingly done, to the study of the masses of official statistics made available because of "food-rationing" and "production-programmes" in the U. K. from 1939-52. These they have used to the full, but have backed them up by field investigations, covering both "consumer" and "producer" reactions to the "*strait-jacket*" of controls and rationalization.

Very wisely, in the opening chapter, a very brief but searching analysis is made of the economic and political setting, which formed the psychological climate for "rationalization" in Britain. In this they have, for example, "high lighted" the war-time effects of "bombing" on the distribution problem, and the need for a great extension of food production in the U. K. to meet the catastrophic drop in overseas income from investments, which prior to War II had paid for 25% of all U. K. imports.

The senior author, of course, knows not only New York Milk Marketing from A to Z, but as a frequent and observant visitor to the U. K. has a firm grasp of the situation here. Therefore, the comparisons and contrasts made in the opening chapters are very relevant to the situation to be found in the two countries. In this particular, they relate chiefly to New York State and neighboring areas where conditions are logically comparable with the U. K. The similarities revealed, contrary to what most folks might think, are even more striking than the differences. The authors show, for example, that basically, the Milk Marketing Board established in 1933 for England and Wales is very comparable to similar type agencies in the U. S., and that the Ministry of Agriculture's function is not unlike the Governmental agencies of the States.

In the comparisons made in Chapters II, III and IV, relating to Production, Distribution, and Consumer Demand, many interesting details of the practices and position in the U. K. are revealed, and will be of value, not only to American readers, but to residents of the U. K. who, very unlikely, have had any previous opportunity to study them in any detail.

Here, the authors should be complimented on their keen observation of subtle, but important factors, as is illustrated in their footnote on page 46, where they refer to the peculiar situation found North of the Border, in Glasgow and Edinburgh. There they draw attention to the sales value of

early "hot breakfast rolls" and its effect on customers, and on hours of milk delivery.

Another factor of major interest is the table referring to consumption of manufactured dairy products. The per capita figure quoted for butter consumption would make British housewives gasp with astonishment and conclude that some margarine got mixed up somewhere in the calculation!

A small point, but it is worth mentioning—In arriving at the subsidies for milk, both direct and indirect, in Table 35, most authorities in Britain would not agree with the figures quoted under fertilizers, ploughing-up and calf-rearing. The primary purpose of these was either, chiefly "grain" production or "store-cattle" rearing—the latter to utilize fully the effects of better grassland, as the result of fertilizer and other treatments.

This is probably a suitable point at which to pay tribute to the wise and generous use of *footnotes*.

The later chapters deal with the price fixing system and its repercussions on "producers," "distributors," "consumers" and the national exchequer," especially in relation to transport as it affects farm collection of milk, and zoning for milk deliveries to consumers. This is probably the area of analysis which will repay closest study, not only by "marketing" specialists, but by all who are interested in social welfare.

The final chapter of summary and conclusions is masterly. Here the authors do not only give their own "confession of faith," so to speak, but review in considerable detail what they think is the most relevant and important detail of the previous text. In this alone, they have "blazed a trail," which, it is hoped, many others will follow, as it simplifies for the present-day harassed economist one of his greatest headaches, that of selecting sources of information, without having to wade through too many deep volumes.

The list of contents, with the admirable bibliography appended, and the graphic portrayal of the most outstanding data are also to be commended for the same reason. The pictures, too (without bias!) are well chosen, as they not only make the publication more attractive, but immediately set the "seal" to its contents and illustrate, as no other medium could, some points worthy of the reader's attention.

This publication should be on the shelf of, not only every marketing economist, but everyone who is interested in the relation between "Government" and "People." It is free of bias and finishes with no dogmatic conclusions, but it sets forth clearly the implications which are as important in these difficult days, for the British and Continental readers, as for the American.

J. R. CURRIE

Dartington Hall, Totnes
Devon, England

American Foreign Assistance, William Adams Brown, Jr. and Redvers Opie, Washington, D. C.: The Brookings Institution, 1953. Pp. 615. $6.00.

This book is a detailed account of the United States Government Foreign Assistance programs for twelve years, 1941-52. It is a result of a complete study and a thorough inquiry into the Assistance programs and the problems associated with them.

As a reference on Foreign Assistance Programs this book is excellent. Professional men who are interested in this field will find it of special value. Laymen will find most of the book rather laborious to read unless they have an unusual interest in this subject. They would find most interest in the last part of the book consisting of about fifty pages. This part is much easier to read and it is the author's real appraisal of the Assistance Programs over the twelve year period. In the main part of the book (90%) many figures are quoted and the facts are stated directly. Perhaps some readers would like more of the statistics in tables and less in the narrative. The book is impersonal in that very few people are mentioned. In a few spots the reader may be puzzled and lost unless he has some aquaintance with some of the organizations participating in the Foreign Assistance Program and an understanding of foreign trade and exchange.

The authors divide the Foreign Assistance into four phases: (1) The period of lend-lease before and after Pearl Harbor, (2) The period of relief to war torn areas and special credits to individual countries for reconstruction, 1945-1948, (3) The period of concentration on recovery in Europe, 1948-1950, (4) The present period of mutual security or defense. The book has two other major parts (1) Assistance Outside of Europe and (2) Summary, Appraisal and Conclusions.

No material is presented in this book on foreign programs of non-governmental agencies such as foundations, missionaries, private business and others. Very little is given on the activities of the United Nations and the agencies of the United Nations. Only one chapter was devoted to the assistance to underdeveloped countries including the Point IV program. No description was given of specific projects.

Over 90 million dollars of foreign assistance has been made available by the United States Government during the twelve years, 1941-52. These funds were used as a means of obtaining the foreign policy objectives of the United States. The use of such funds in such scale to support our foreign policy is unprecedented in history.

The authors bring out the important point that the peace and security of the United States have come to be regarded by the American people as inextricably bound up with what is happening elsewhere in the world. It is taken for granted now by many people that the United States in its

own best interest should use its vast influence and strength to bring about the conditions of peaceful and mutually beneficial political and economic relations. Also, the preservation of human freedom requires a cooperative effort on the part of all freedom loving nations.

In carrying out our Foreign Assistance Programs, two outstanding misconceptions are noted by the authors:

1. That our assistance has been designed mainly for the purpose of disposing of surplus commodities to stave off capitalist depression and ultimate collapse and to continue in new form the old capitalist-imperialist expansion. (Promoted by communist propaganda.)
2. That foreign assistance is based on some equalitarian concept of social justice and that the United States should assist other countries because we are better off than they are.

The authors bring out three important aspects of our assistance programs that have not been officially clarified:

1. The kinds of European integration that are desirable and necessary to attain maximum economic and military strength within the framework of the Atlantic community and with due regard to the rest of the world.
2. The relation of technical assistance or the Point IV program and the provision of capital. I think this point needs special emphasis. In budgets the technical assistance work has been confused with direct economic assistance and even military assistance. Reports of objectives and accomplishments have been misunderstood by our people.
3. The relation between economic and military assistance. With defense and security efforts more strongly in mind since 1950, military assistance has been stressed and is more acceptable by our people than economic assistance. Economic assistance has been pushed into the background. Its contribution to defense and security is thought to be more indirect. However, it may be just as important. The declining enthusiasm for economic assistance in many cases even included technical assistance. The authors indicate that because of this need for greater understanding of economic assistance, a larger part of this book was devoted to that area rather than military assistance.

The assistance programs of our government have varied greatly as to type of programs and in methods used. They have been continuously expanded, modified, and discarded in the attempt to formulate and execute our foreign policy. The problems with these programs as well as our whole international relationships are tremendous. We have been accused many times of interfering in the affairs of other countries. There is a great need for strong and relatively stable economies in this country and in other countries, if we are to avoid the dissipation of some of the great accom-

plishments attained through our assistance programs.

As emphasized in this book, I believe one of the greatest opportunities for the United States lies in the field of our foreign trade policy. What we do in taking the lead in liberalizing trade policy is likely to be an important key to further reconstruction of the world.

United States needs to be prepared to live a long time with the struggle against economic, political and military insecurity in many countries of the world.

MERVIN G. SMITH

Ohio State University

California Administrative Law and Procedure, Carl Kuchman, San Francisco: Colman Law Book Co., 1953. Pp. 376. $10.00.

The federal government has for many years provided assistance to the agricultural economy, laid down regulations governing processing and trade, and in recent years intervened directly in the determination of farm prices or outputs. Except for the last function, the state governments have done likewise. The statutory standards governing operation of these programs by executive units or special administrative agencies have necessarily been broad and general. In consequence, such agencies have acquired quasi-legislative and judicial powers in setting up rules and regulations to implement broad statutory standards, in making findings, and in rendering decisions. Thus, in all elements of agricultural policy, effects of laws have in part been determined by policies and practices of administrative bodies.

This book is the first to define systematically the sources and limits of such administrative power. It is documented carefully. It is essentially analytical in character. In style, it is economical and precise but fluent. There are four parts. The first indicates that the major reason for delegation of legislative or adjudicatory power to administrative agencies is that reasonable efficiency and equity of governmental operation could not otherwise be obtained in an expanding government increasingly intervening into a complex economy. The limitations which restrict delegation are spelled out and tests for the sufficiency of statutory standards are appraised. The legal bases for the broad types of administrative authority—express versus implied and ministerial versus discretionary, as examples—are analyzed in the second section. The third part treats the principles which define the powers, duties, and procedures in undertaking administrative action, in promulgating regulations, making decisions, or obtaining review. The last section re-enforces the analytical core of the first two parts in defining the principles which govern the ultimate authority of courts in review of administrative action. The third section is useful to economists mainly by indi-

cating the practices and procedures now general among administrative agencies. The other three make clear the reasons for the acquisition of essentially legislative and judicial authority by such agencies, the determinants of the scope of their authority, and the impact of their operations upon the declared objectives of the legislatures.

The book deals mainly with California law but the principles appear to be generally applicable to administrative law in the federal and the other state governments. Much of the referencing of the book is of use only to lawyers. The sheer necessity for broad administrative latitude in execution of most agricultural policies makes this subject quite as important to economists as to lawyers. Its study will be fruitful for economists whose work involves analysis of operations of governmental programs.

GEORGE L. MEHREN

University of California
Berkeley, California

Cultural Patterns and Technical Change, edited by Margaret Mead, Paris: UNESCO, 1953. Pp. 348. $1.75.

Technical change is as old as civilization. Since time immemorial the ways of people have been transformed by the introduction of new tools and new techniques. The assumption, on the international scale, of responsibility for introducing changes in "underdeveloped areas" is, however, something new. "New also is the recognition and willingness to deal scientifically with the concomitant effects of such change" (p. 9). The survey was made by UNESCO primarily in order to see what kind of tensions these changes are causing in the minds and hearts of the "developing" people.

The first half of the book is devoted to some case studies of whole cultures of Burma, Greece, The Tiv of Nigeria, Palau in the South Pacific and the Spanish Americans in New Mexico. The rest of the book extracts some general principles from the cases investigated or "Cross-cultural studies of aspects of technical change" as the chapter is headed.

The discussion of the individual "cultures" makes absolutely fascinating reading. Culture is defined as the "abstraction from the body of learned behaviour which a group of people, who share the same tradition, transmit entirely to children, and in part, to adult immigrants who become members of the society" (p. 9). This kind of a definition strikes an economist as somewhat "fuzzy." But after some hundred pages of Greek proverbs, poetry, the role of the "Familia" and the "Patron" in the New Mexico—to pick some few diversified items—"culture" becomes a term no less abstract than say marginal efficiency of capital. Miss Mead is at her best in this part of the book.

The survey is primarily intended for the use of people actively engaged in guiding technological change. This group includes just about everybody in the field, regardless of whether they are heads of missions, expert technicians, members of government in the receiving countries, or some of the "Washington desk cowboys" employed by the US, UN, or any other country participating in technical assistance. This, of course, does not mean that here is a how-to-do-it book. It is not a blueprint giving answers to questions like: When do you call in a religious leader? What is a better substitute for magical practice, a modern doctor disguised as a magician or openly recognized as an MD? But if somebody is looking for level headed lessons collected over many years at the price of disastrous missteps, plans that misfired and plans that succeeded, then this is the publication where one can find it. It is a shortcut to experience.

One only wishes that our State Department would employ more anthropologists and fewer headline-minded public relations experts. This might conceivably run our "friendship of foreign peoples" column much higher on our diplomatic balance sheet. In fact, one does not even have to go abroad in order to find application for some of the book's principles. A trip to New Mexico, Arizona or any Indian reservation would illustrate the kind of mental tensions, which emanates from unbalanced technological change. Just because "culture" is an intangible factor does not mean that it should be ignored in the process of economic development.

FRANK MEISSNER

Cornell University

Farm Credit in Underdeveloped Areas, A Summary Report of the International Conference on Agriculture and Cooperative Credit, by Thomas C. Blaisdell, Jr., Elizabeth K. Bauer, Henry E. Erdman and Irving F. Davis, Jr., Washington, D. C.: Foreign Operations Administration, 1953. Pp. 80. App. I-V.

In the development of technical cooperation activities in agriculture, interest in credit has grown somewhat more slowly than in other phases of such work. In recent years, however, increasing emphasis has been given to the need for supporting advances in technology with improved facilities for capital accumulation and credit. A byproduct of these efforts is a steadily growing store of literature on the credit aspects of technical assistance in agriculture and the role of capital and credit in increasing production in underdeveloped areas.

The largest additions to this literature resulted from the International Conference on Agricultural and Cooperative Credit, held at the University of California beginning August 4, 1952. In addition to the University, this Conference was sponsored by the Technical Cooperation Administration

in the Department of State, the Mutual Security Agency (combined in the Foreign Operations Administration, Department of State on August 1, 1953) and the Department of Agriculture. The 64 delegates from 32 countries spent the first six weeks on the Berkeley campus and in short field trips to points near Berkeley. The Conference then divided into two groups for organized inspection tours across the United States. The final sessions were in Washington, ending on October 2.

The detailed proceedings of this Conference were published in two volumes and constitute a valuable source of information on problems in accumulating capital and building credit systems in underdeveloped areas.[1] They include also descriptions of agricultural credit systems in a large number of countries, prepared by delegates to the Conference. In addition, the University published a compilation of readings in agricultural credit and capital formation for use by the Conference.[2]

The subject of this review is a summary of the *Proceedings* of this Conference. In addition to reducing 1093 pages of *Proceedings* to more manageable proportions, this summary provides a good, short presentation of the principal problems in capital formation and establishment of agricultural credit facilities in underdeveloped countries. The first of the five chapters describes the general plan of organizing the Conference and some of the philosophy behind it. Chapter 2 is a review of ideas developed at the Conference with respect to the nature of capital, its formation, how it can be mobilized and then redistributed in the form of loans to those who can use credit. Problems in borrowing capital from abroad are discussed. The third chapter covers cooperative credit and its possibilities and limitations in an underdeveloped economy. Forms of organization and other problems in establishing cooperative credit systems are summarized. There are brief descriptions of the cooperative credit systems in India, Japan, Thailand, and Indonesia.

Supervised agricultural credit is the subject of Chapter 4. Its role in underdeveloped areas is emphasized. Various problems and policies in credit supervision are discussed and evaluated. In developing the ideas in Chapters 2, 3 and 4, liberal and effective use is made of illustrations from countries all over the world and of to-the-point quotations from or citations to comments by delegates, reported in full in the *Proceedings*.

Finally, Chapter 5 is a summary of the philosophy of the Conference

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[1] *Proceedings of the International Conference on Agricultural and Cooperative Credit*, August 4 to October 2, 1952, Elizabeth K. Bauer, editor, Berkeley, California: University of California, 1952. 2 vols.

[2] *Selected Readings in Agricultural Credit*, Irving F. Davis, Jr., editor, Berkeley, California: University of California, 1952. 582 pp.

with respect to the worldwide scope and the variations in the problems previously discussed. Some rough guides in applying the principles are outlined. The resolutions adopted by the Conference are given in full in Appendix I. Other appendixes give names and countries of the delegates, the contributors and other details of the Conference.

This is a well-organized, readable summary of this important Conference and will be particularly useful to anyone who wishes to obtain a quick view of problems and considerations in technical assistance work in the field of agricultural and cooperative credit.

R. C. ENGBERG

Farm Credit Administration

LIST OF DOCTORAL THESES COMPLETED IN AGRICULTURAL ECONOMICS, 1953
ADDENDUM

Name and Institution	*Title*
Babbar, Madan Mohan Iowa State College	Statistical Approach in Planning Production Programs for Interdependent Activities
Goldman, Alan Stewart Iowa State College	Efficiency of Marketing Eggs in Des Moines
Held, Royer Burnell Iowa State College	Overcoming Obstacles to Soil Erosion Control in Western Iowa
Hess, Carroll Vernon Iowa State College	Personal, Social and Economic Factors Conditioning Farmers' Decisions and Resource Use on Central Pennsylvania Dairy Farms
Kehrberg, Earl Wayne Iowa State College	Adaptation of Economic Production Logic to Feed Utilization by Livestock
Peterson, Gustof Adolph Iowa State College	Use of Input-Output Analysis in Estimating the Interdependence of Agriculture and Other Economic Sectors
Shaw, Harold Russell Iowa State College	Resource Productivity in Agriculture
James H. Street University of Pennsylvania	The Mechanization of Cotton Production: A Case Study in the Theory of Economic Development
Thair, Philip James Iowa State College	Responses of Farmers to Differences in Crop Yield Variability in Two Counties in North Dakota
Toussaint, William Douglas Iowa State College	Farm Rental Obstacles to Land Improvements and Suggested Solutions
Vincent, Warren H. Iowa State College	Economic Principle as a Guide to Administration and Teaching in the Agricultural Extension Service
Wiegmann, Fred H. Iowa State College	Comparison of Costs of Service and Self-Service Methods of Selling Meat in Retail Food Stores

NINTH INTERNATIONAL CONFERENCE OF AGRICULTURAL ECONOMISTS

Time and Place of Meeting: Helsinki, Finland, August 20-30, 1955
Theme: The Impact of Technical Advance in Agriculture—upon the Economics of Farms, National Welfare and International Trade.
Conference Site: The Finnish group have reserved space in the new Technical College dormitories near Helsinki—fifteen minutes by bus. They are located amidst the typical trees and lakes of Finland, with a magnificent *sauna* (Finnish bath) at the edge of the lake. (For the uninitiated the President and Secretary can strongly recommend this experience from a previous visit!). There are ample and comfortable quarters for a large gathering. The beauties of the surroundings surpass the statements of the guidebooks. There will be a very reasonable inclusive charge of about $4.00 per day.

For all interested in farming and forestry (not to mention trout fishing) the countryside abounds in attractions. The old established homesteads with their typical rectangular fields interspersed with water channels and fine looking herds of dairy cows testify to the diligence of the farmers. These almost match the operator's love and care for trees. Ample time will be given for seeing these during and following the Conference. Several tours of Finland are proposed.

Pre- and Post-Conference Tours: Plans are being made for the usual tours starting and ending at either London or channel ports. Danish and Swedish members are anxious to help show something of the agriculture of these countries while traveling by bus to and from Stockholm, from which port the party would sail to Helsinki. About ten days are allocated to each tour. This may be a rather long time to take part both ways, but it is hoped that participants will give their names and intentions so that places for outward and return journeys can be matched and adjusted.

The tentative proposals are for an outward route via Belgium, Holland (Zuider Zee), to Hamburg and Northern Denmark, thence to Göteborg, Karlstad and Stockholm. The inward trip would follow the eastboard road via Karlskrona and Malmö, to Copenhagen, Southern Denmark, Grossenbroda, Hanover, Frankfurt, thence to the Channel ports. Estimated costs at present are about £3 per day plus about £30 for transport, Antwerp or Ostend to Helsinki and return. Round trip by air from London to Helsinki is £76 first class and £67 tourist; by sea and rail it is £65 first class, £45 second class and £35 third class.

J. R. CURRIE

NEWS NOTES

W. J. Anderson of the University of British Columbia is working with a group of eight Canadian economists at Queen's University, Kingston, Ontario on research projects pertaining to Canadian economic policy.

Richard D. Aplin of the University of Vermont, has been granted a two year's leave of absence for a tour of duty with the United States Air Force.

L. H. Barnes, Ohio State University, will conduct a workshop in the Graduate School of Theology at Oberlin College, July 5-23. This workshop will be concerned with current problems of Agriculture and Farm Families.

John D. Black, Harvard University, and H. L. Stewart of the Production Economics Research Branch of the ARS returned in mid-June from a two-month assignment in India for the Foreign Operations Administration. They carried out a survey of activities in agricultural economics and made recommendations for expansion and improvement of research, extension, and teaching of agricultural economics in India.

L. L. Boger has been appointed Head of the Department of Agricultural Economics at Michigan State College.

James T. Bonnen, who has completed his work at Harvard, has been appointed Assistant Professor at Michigan State College. He will work in marketing research.

C. A. Bratton was promoted to Professor at Cornell University in April 1954.

James O. Bray of Kansas State College has been granted a fellowship from the Fund for Advancement of Education. Mr. Bray plans to use the fellowship for study at Oxford University.

H. C. M. Case has returned to the University of Illinois after a sabbatical leave to study trends in agricultural development in the "Old South."

Emery N. Castle became Assistant Professor at Oregon State College on July 1, transferring from the Kansas City Reserve Bank. He will teach in Farm Management, Production Economics and do research in the general area of resource development.

Norman Collins was appointed Assistant Professor of Agricultural Economics at Kansas State College effective July 1.

Thomas K. Cowden has been appointed Dean of Agriculture at Michigan State College.

Charles R. Davenport, after doing graduate work at the University of Maryland, accepted a position as Agricultural Economist with the Foreign Agricultural Service, U. S. Department of Agriculture.

Robert Lee Davis, Assistant Professor, returned to Mississippi State College July 1 after a leave of absence for graduate work at the University of Kentucky.

J. W. Fanning resigned as Extension Agricultural Economist in February to become Associate Director of Community Service, The Georgia Center for Continuing Education.

William S. Farris joined the Purdue staff as an Extension Specialist in marketing July 1. For the past two years he has been a graduate assistant at Purdue. Part of that time he taught Agricultural Economics at Arkansas State College. He did his undergraduate and Master's degree at the University of Arkansas.

John L. Fischer was promoted to Associate Professor at the University of Tennessee.

Homer Fletcher has resigned from Kansas State College in order to accept a position in program planning at the Tractor and Implement Division of the Ford Motor Company.

The Food Research Institute of Stanford University announces the following additions to its staff: S. Daniel Neumark, as acting economist, and Dr. Roger Winks Gray and Dr. Bruce Foster Johnston, as acting associate economists.

George E. Frick of the Production Economics Research Branch of the ARS, stationed at Durham, New Hampshire, received a Superior Service Award from the USDA at the Eighth Annual Awards Ceremony conducted in Washington, D.C. in May "for preparing and interpreting economic research results so as to facilitate their use by farmers in making their own farm management decisions."

A. B. Hamilton, University of Maryland, has been appointed the group leader and technical consultant for 16 men from Yugoslavia. They are managers and technicians who will work in Maryland food processing plants for four months to learn new methods and techniques before returning to their native country.

Robert N. Hampton was appointed Assistant Professor in Marketing at Cornell where he will conduct research in floricultural economics.

Harold W. Hannah, Professor of Agricultural Law, has been promoted to Associate Dean in the College of Agriculture at the University of Illinois.

Clifford Hardin, Dean of Agriculture at Michigan State College, became Chancellor of the University of Nebraska on July 1.

E. H. Hartmans, formerly of the Netherlands, is now Extension Economist at the University of Minnesota.

Earl O. Heady spent the summer with the agricultural economics group at the University of California at Berkeley, as a final phase of a Faculty-Research Fellowship grant by the Social Science Research Council.

Glen W. Hedlund was appointed Head of the Department of Agricultural Economics at Cornell in May 1954.

J. A. Hodges of Kansas State College taught Advanced Farm Management and assisted with a work shop in Farm Management during the first term of the summer session at the University of Arkansas.

Robert R. Hudelson will retire from his duties as Dean of the College of Agriculture at the University of Illinois on September 1, 1954. He has completed over 40 years of service at the University of Illinois.

Edwin B. Jones has resigned from Michigan State College to accept a position with the Ford Motor Company.

C. D. Kearl, Cornell University, left in June 1954 for a year with the Mutual Security Administration Project, College of Agriculture, University of the Philippines.

Joseph T. Keeler is leaving the University of Illinois to become an Assistant Professor at the University of Hawaii.

Edward E. Kern of Mississippi State College has been awarded an Economics-in-Action Fellowship by the Case Institute of Technology for the period June 20 to July 31, 1954.

Robert Kramer has been made responsible for the over-all coordination of the Extension marketing program at Michigan State College. This pertains primarily to the use of the special state appropriation of $144,000 new moneys for agricultural marketing.

Erven J. Long of the University of Tennessee has accepted a 3½ months' appointment to Belgium and the Belgian Congo, beginning in mid-June 1954. Joe A. Martin will serve as Acting Head of the Department at the University of Tennessee during Dr. Long's absence.

W. W. Moffett, Regional Dairy Marketing Research Project Leader, has accepted the position of Supervisor, Milk Audit Control, Mississippi Department of Agriculture, effective July 1.

Francis E. Montville has joined the staff of the University of Rhode Island as Research Assistant in Farm Management.

William G. Murray has asked to be relieved of administrative duties at Iowa State College effective September 15th in order to devote full time to research and teaching. When appointed in 1943 he felt that it would be desirable not to serve more than 10 years. He suggested that a reassignment of duties be made last year, but agreed to remain as department head for an additional year at the desire of the administration.

Ernest J. Nesius returned in May to research and teaching in Production Economics at the University of Kentucky. During his two-year leave he was Assistant Food and Agriculture Officer in Austria and later in Belgrade, Yugoslavia. In both countries his work was primarily concerned with economic and technical assistance for country development programs.

Charles R. O'Kelley has been appointed Associate Economist. Mr. O'Kelley has, for the past several years, been County Agricultural Agent of Brooks County, Georgia.

Russell O. Olson of the Production Economics Research Branch of the ARS at Columbus, Ohio, taught a six-week course in agricultural economics at the Garrett Biblical Institute, Northwestern University.

Harold Rabinowitz, after doing graduate work at the University of Maryland, accepted a position as Agricultural Economist with the Agricultural Marketing Service of the U. S. Department of Agriculture.

Fletcher Riggs will return to Kansas State College on September 1 after a year's leave for advanced study at Vanderbilt University.

Lynn S. Robertson, returned to Purdue University in August after a year's leave of absence with the Agricultural College of the University of the Philippines. Dr. and Mrs. Robertson went to the Philippines a year ago via California and Japan. They will return by way of India, Rome, Paris, London, and New York.

K. L. Robinson was promoted to Associate Professor at Cornell University in April 1954.

Niels Rorholm, who received his Ph.D. degree at the University of Minnesota in March 1954, has joined the staff of the University of Rhode Island as Assistant Professor of Farm Management and Production Economics.

Waldo S. Rowan has been promoted to Associate Professor at the University of Georgia. He is spending half time in marketing research and half time in college teaching.

Rainer Schickele resigned as Chairman of the Department of Agricultural Economics, North Dakota Agricultural College, as of August 1, 1954. He has accepted the position of Chief, Land and Water Use Branch, Food and Agriculture Organization of the United Nations with headquarters at Rome, Italy. He has also accepted the invitation to become a charter member of the National Council of the National Planning Association.

R. G. F. Spitze was promoted to Associate Professor at the University of Tennessee.

W. P. Stephens at New Mexico A. and M. College, is on leave for one year for graduate work at the University of Minnesota.

Edwin G. Strand has taken a one-year leave of absence from the Production Economics Research Branch of the ARS for graduate study at Iowa State College.

Orion Ulrey has been granted a leave of absence from Michigan State College, effective September 1 to accept a Fulbright scholarship in Pakistan.

Arthur J. Walrath of the Production Economics Research Branch of the ARS has completed his assignment with the Columbia Inter-Agency River Basin Committee at Portland, and has transferred to Madison, where he will do cooperative work with the Department of Agricultural Economics at the University of Wisconsin.

E. J. Working has accepted the position of Professor of Agricultural Economics and Chairman of the Department of Agricultural Economics at the State College of Washington as of August 1, 1954.

Dean E. C. Young, Dean of the Purdue University Graduate School, will visit certain Central and South American countries July 15 to September 1 as a representative of the Rockefeller Foundation. He will spend most of his time in Mexico and Colombia, although he plans also to visit Costa Rica and Panama. He will develop a basis for counseling the Rockefeller Foundation relative to its agricultural programs in the countries which he visits.